MECHANICS' MAGAZINE,

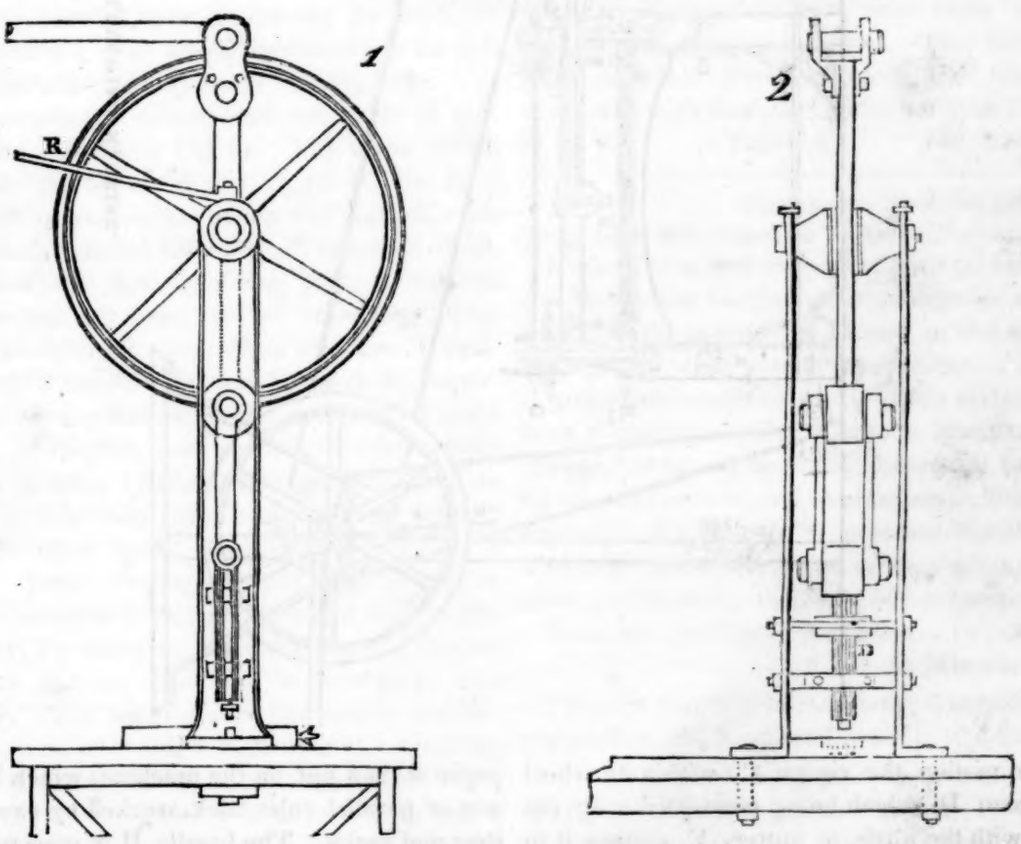
AND

REGISTER OF INVENTIONS AND IMPROVEMENTS.

VOLUME I.] **FEBRUARY, 1833.** [NUMBER 2.

——————— Art thrives most
Where Commerce has enriched the busy coast;
He catches all improvements in his flight—
Spreads foreign wonders in his country's sight—
Imports what others have invented well—
And stirs his own to match them, or excel.—COWPER.

PAPER STAMPING MACHINE.

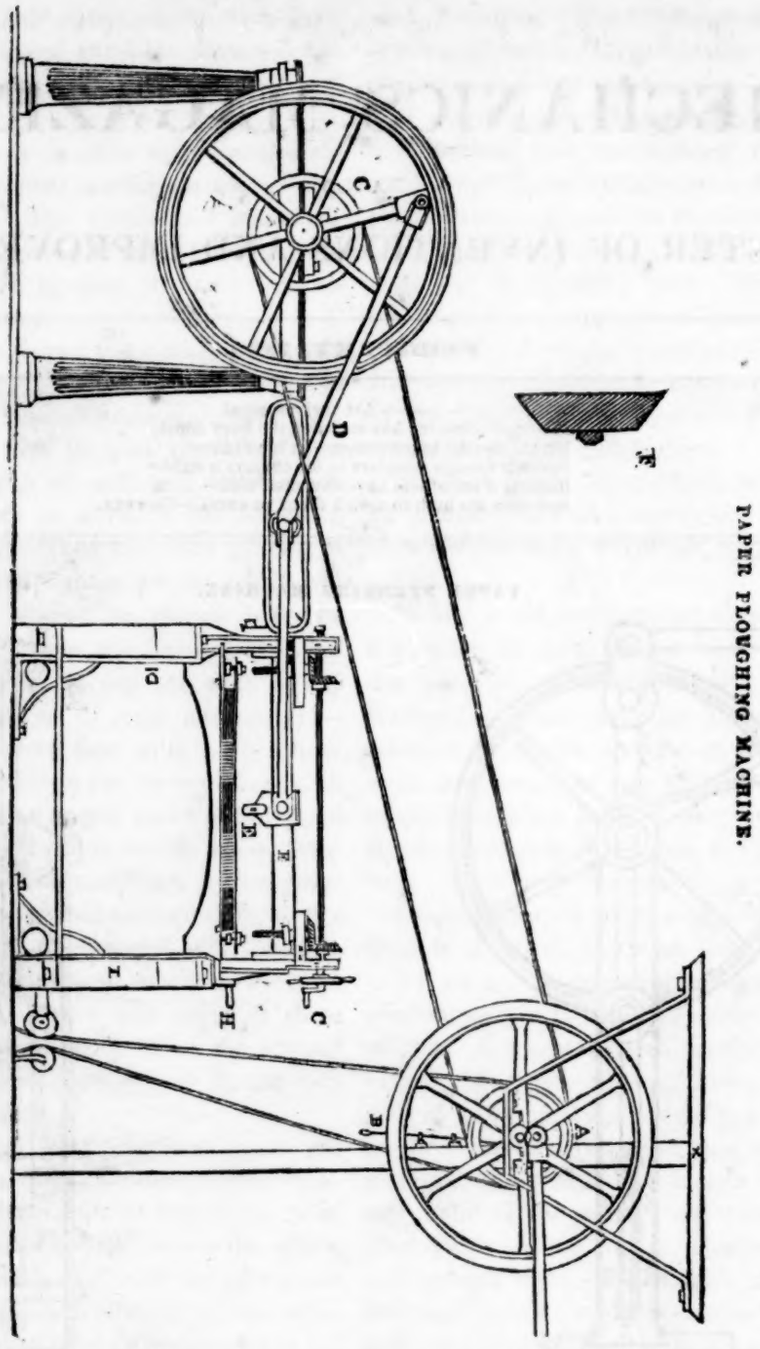


Paper Ploughing and Stamping Machines. By Mr. WM. REED. [From the London Mechanics' Magazine.]

Peterhoff Paper Mill, near St. Petersburgh, August 23, 1831.

I now propose to give a description of a machine for ploughing five reams of paper at a time, which has been at work here nearly ten years, and is an invention entirely my own. I am not aware of there being any thing of the kind in England, owing, I believe, to the excise not allowing any paper to be ploughed at the mills, so that the stationers are obliged to get it ploughed by hand. In places where there are no such vexatious regulations, this machine will be found of great use. Two boys suffice to manage the working of it; and those here have got exceedingly expert in placing in and taking out.

I shall begin with first describing the principal working parts of the machine. Two riggers, A, are driven from below off one of the engine-woolers; and on the shaft there is a sliding clutch-box with a lever, marked B, for instantly stopping or starting the machine.—From one of the riggers a strap proceeds, which



PAPER PLOUGHING MACHINE.

sets in motion the rigger C, with a fly-wheel and arm D, which being connected with the head with the knife, or cutter, E, causes it to slide along the bar F, which is of a triangular form, as represented in the section F'. G is a handle, by turning which, with the help of two pair of mitre wheels, fixed on a shaft, and the vertical screws attached to the bar F, the knife bar, &c. is made to descend. The mode of operating is as follows: On the machine table or platform, we place each ream on its beech-board, for the ploughing knife E to cut down to. We then lay on a sheet-brass gauge plate, and mark off with a pencil how much of the three external sides are to be cut away. The paper is then put on the machine, which has a sort of parallel ruler back, worked by two pinions and racks. The handle H is now turned towards the workman, and the pencil mark brought level with the front of a double iron straight-edge. The lower edge is fixed firm and level with the table; and at each end there is a $1\frac{1}{2}$ inch cylindrical pin cut, with a double screw (for dispatch) and two brass nuts, of which the lower one is round, and works slack, being intended merely to hold the upper straight edge, while the reams are put in and taken out. When the paper is in its place, the under or counter nuts are run down an inch or so; the upper nuts, which are six-sided, are

screwed down tightly, by two short spanners, on the five reams of paper, care being taken to screw both ends of the iron straight-edge down at one time. The lads broke three cast-iron straight-edges before they got well used to the machine, by not screwing down equally. The last one I backed with two half-inch bars, clamped on edgewise, and it has lasted years. It sometimes happened that one ream of paper was rather thicker than the others; but by slackening the bar, and putting two or three sheets of paper on the thin ream, the inequality was easily remedied; now such a thing seldom occurs. After one face has been thus ploughed, the clutch is detached by the lever B, and the handle G being quickly turned the reverse way, brings up the bar with the knife or cutter E. The upper nuts are then slackened, and the parallel back, by moving the handle H as required; after which the reams are turned, and again brought up to the straight-edge.

The table and sliding-back are made of mahogany, the frame I of fir. The frame which carries the fly-wheel and rigger C, &c. is of cast iron, and square at top and bottom, with four hollow fluted columns. The guide-wheel, mitre-wheels, and the sliding parts at the end of the bar and head, are of brass kept clean. The ploughing-knives, when new, are 10 inches long, 2 inches wide, and 3-8ths thick, requiring to be very flat on the face, and stiff. I make them of English cast steel, and when worn down to about 7 inches, they are considered as having done their duty, and are then worked up into other tools. Four or five will last a year. It may be proper to add, that the post or frame marked X reaches from the floor to the ceiling, for carrying the shaft, fly, and riggers A, and that the other end is fixed on an iron cradle. The knife makes 25 double strokes per minute of 4 feet 6 inches; if the machine worked quicker, it would heat the knife.

I take the opportunity of also sending you a description of a machine for stamping the paper at the corner, in three or six sheets at a time, which is worked in connection with the ploughing apparatus. It is of wrought iron, except the wheel, which is cast, and the whole is fixed firmly on a fine beech table. On the top of the frame are two stout iron rods, which help to support it from the thrusts, &c. A tapet on a short crank is put in motion from the shaft and rigger A (see ploughing apparatus,) and with the connecting rod, pushing the wheel to and fro, causes the cylinder (D, front view, fig. 2,) to rise about half an inch, which is sufficient. The peculiarity of this press is, that by one turn of the crank it makes two blows or impressions 50 times per minute. We before used a small hand press, but this is more expeditious, and saves a man, which is an object where men are scarce. In all parts of this machine, the axle and bolts are two inches thick: were they smaller, the great strain would soon make them slack in the joints. The bed-pieces are pewter or grain-tin, three inches square, and 1½ inches thick, cast with a pin on them, thus:

to chuck them by; because when the die is forced in too deep, it is apt to cut the paper. They are then faced in the lathe, and pasteboard washer put under to raise them up to give the impression required. The tin bed-piece is let into a wooden block, that takes in two parts, with feather-nuts on bolts, as shown in fig. 2. Yours, &c. W. Reed.

Brooklyn, Feb. 24, 1833.

To the Editor of the American Mechanics' Magazine:

Sir,—The announcement of your publication for Mechanics has excited considerable attention from the practical workmen in this neighborhood. I wish you every success. I think if you would insert in one of your early numbers a complete "Glossary of Mechanical Terms," it would be highly beneficial to many of your readers and subscribers. There is one in Mr. Nicholson's "*Operative Mechanic*," a work of great merit, but of too high a price to be purchased by the mass of workmen.

I am, sir, your most obedient,

A Young Mechanic.

[We are thankful to our young friend for his suggestion, and most readily adopt it.—Ed.]

A GLOSSARY OF MECHANICAL TERMS.

Æolopile—A hollow metallic ball, with a small orifice, to show the power of steam.

Anneal—To expose iron or other metals to the action of fire, in order to reduce them to a greater degree of tenacity.

Anvil—A block or mass of iron, with a hardened steel surface, on which smiths and other artificers hammer and fashion their work.

Arbor—The principal spindle or axis which communicates motion to the other parts of a machine.

Arm—The length of the sail of a wind-mill measured from the axis.

Arms (*axle*)—The two ends of an axle-tree: projecting supports in machinery.

Ash-hole—A receptacle for the ashes which fall from the hearth of a furnace.

Attraction of cohesion—The attraction which holds the particles of matter to each other.

——— *of gravitation*—The force which causes all ponderous bodies to fall towards the earth's centre.

Augur—The wimble or tool used in the boring of woods.

Automaton—A machine which, by an internal arrangement, seems to move of itself.

Axis—The spindle or centre of any rotatory motion.

—— *of oscillation*—The shaft upon which any body vibrates.

—— *in peritrochio*—One of the six mechanical powers; usually called the wheel and axle.

—— *of rotation*—The shaft round which any body revolves.

Backboards—Boards attached to the rims of the water-wheel, to prevent the water running off the floats into the interior of the wheel.

Backlash—The hobbling movement of a wheel not fixed firm on its axis.

Back-water—The water which impedes the motion of a water-wheel, or from other causes.

Balance—An instrument which, by the application of the lever, exhibits the weights of bodies.

Batten—The movable lath or bar of a loom which serves to strike in or close, more or less, the threads of a woof: a long narrow slip of wood in carpentry.

Batter—A machine used early in the process of the cotton manufacture.

Bayonet—A piece of wood or metal with two legs to disengage and re-engage machinery: *vide* Mill-Geering.

Beats—The strokes made by the pallets or fangs of a spindle in clock or watch movements.

Beetle—An implement for flattening the texture of linen or woolen cloth: a heavy mallet.

Bevel-geer—Wheels in which the teeth are set at angles of various degrees from the radius.

Bitts—Small tools used in boring.

Bloom—A bar of iron to be passed through the rollers of an iron-mill to be elongated into a bar, rod, or hoop.

Blunging—The act of mixing or kneading clay for the potter's use.

Bobbins—Little circular pieces of wood on which the thread of cotton, silk, &c. is wound.

Bolter—A machine for sifting meal.

Bolting-cloth—A cloth through which the sifted meal runs.

Brace—A curved instrument of iron or wood for moving small boring tools called bitts.

Bracket—A support fixed to a wall.

Brake—A machine for separating the cuticle or outer skin from the flax plant.

Brazing—The soldering or joining two pieces of metal by melting of brass between the pieces to be joined.

Breast—The first part of a revolver carding-engine.

Breasting—The circular sweep of masonry, &c. which surrounds the shuttle side of a breast-wheel.

Breast-plate—A small piece of steel with holes to receive the ends of a drill.

Breast-wheel—A water-wheel on which water is admitted at or nearly level with the axis.

Buff-stick—A piece of wood covered with buff leather, used for polishing.

Bullet—To alter the wards of a lock in such a manner that they may be passable by more than one key.

Bush—A hole in the nave of a wheel.

Cæteris paribus—Other things being equal,

Calibre—The diameter of a hole.

Calk—To force oakum, tow, or other material in the joints of vessels, to make them steam, air, or water-tight.

Camb—An eccentric.

Capstan—A vertical post resting on a pivot and turned by powerful arms or levers, to raise heavy weights by crane work; a windlass.

Carbon—Charcoal.

Card—Piece of leather containing numerous iron-wire teeth, forming a species of comb; *vide* Cotton Manufacture.

Case-harden—The process of converting the surface of iron into steel.

Casting—The act of forming metal or other matter into any required shape, by pouring it into moulds while in a fluid state.

Catch—Various contrivances in mechanics, to act on the principle of a latch.

Cement—A composition for joining hard bodies.

Centre-bit—A boring tool in carpentry.

Centrifugal—Flying from the centre.

Centripetal—Flying to the centre.

Chafery—A kind of forge in the iron manufacture, where the metal is exposed to a welding heat.

Chaliometer—An instrument to measure heat.

Chamfer—A groove to receive the tenon in carpentry.

Checks—A term generally applied to those pieces of timber in machinery which are double, and correspond with each other.

Chord—Perpendicular let fall from any radius of a circle.

Chuck—That part of a lathe which revolves with the arbor: to this is affixed the article to be turned.

Circumference—The measure round any circle.

Clack—A bell so contrived that it shall ring when more corn is required to be put in the mill.

Clamp—A pile of unburnt bricks raised for burning.

Clip—An arrangement to impede velocity by friction.

Clutch—*Vide* Bayonet.

Cockling—To entangle.

Cocoon—A small ball of silk spun by a silk-worm.

Cog—This word, correctly speaking, implies teeth formed of a different material to the body of the wheel; but is generally used to express all kinds of toothed wheels.

Concentric—Having the same centre.

Conspiring forces—Various forces combined into one.

Constant forces—Force without interruption.

Contractile forces—Forces which decrease.

Core—The internal mould which forms a hollow in foundry: as the hollow of a tub or pipe.

Countersink—To take off the edge round a hole to let in a screw-head, that it may be even with the surface.

Couplings—To connect two shafts or spindles longitudinally.

Coupling-box—A strong piece of hollow iron to connect shafting and throw machinery in and out of geer.

Crank—A bent part of a shaft, by means of which a rectilinear motion is gained.

Crow-bar—A strong bar of iron used as a temporary lever.

Crown-wheel—A wheel which has teeth at right angles to its radii.

Cycloid—A geometric curve.

Cylinder—A long round body; a roller.

Dam—The bank or wall which pens back the water in a mill-head.

Data—Facts from which we may deduce results.

Decimeter—To measure by tenths.

Dent—The wire staple which constitutes the tooth of a card.

Devil—A machine for dividing rags or cotton in the first process of the manufacture of paper or cotton.

Diameter—The line which passes through the centre of a circle.

Die—Pieces of steel for cutting screws, having the threads countersunk on them: a stamp.

Doffer—That part of a carding machine which takes the cotton from the cylinder.

Doffing-plate—The plate which receives the cotton from the doffer.

Dog—A piece in small machinery which acts as a pall.

Draw-plate—A steel plate, having a gradation of conical holes, through which metals are drawn to be reduced and elongated.

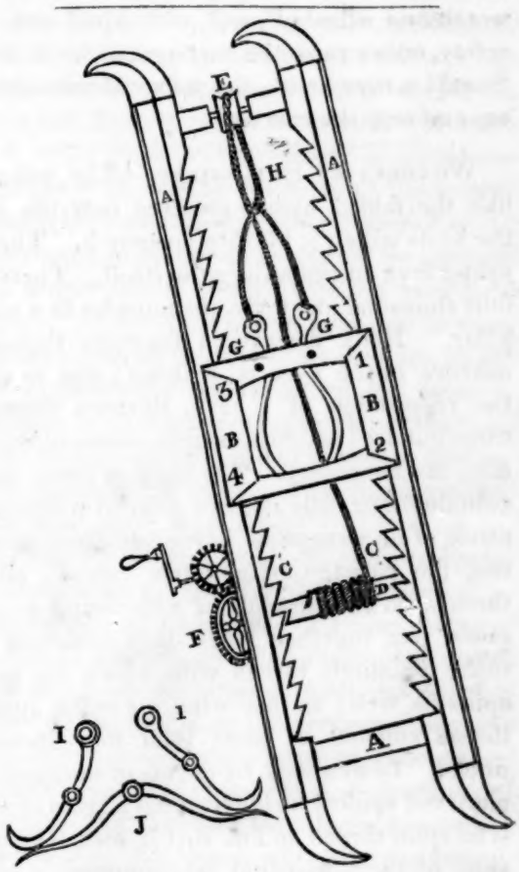
Drench—To wet or inundate.

Drill-bow—A small bow moved by hand to impart motion to a drill.

Drum—A hollow cylinder.

Ductile—Malleable and soft.

(*To be continued*)



Improved Cellar Steps. By R. Gooch. [From the London Mechanics' Magazine.]

Sir,—The prefixed is a rough sketch of a machine, which was invented by me a few years ago, for the purpose of raising casks out of cellars. A model of it was sent to the Mechanics' Institution of this city, and purchased by it—at a price, however, which rewarded me

very inadequately for the trouble the invention had cost me. The advantage of this machine over those in common use is, that provided a rope should break or slip by accident, no injury can be sustained, either to the goods or to the person employed, which now too often occurs.

AAA is a strong wooden frame, of such size and length as may suit the work or place it is intended for. The inside of the frame is rabbited, and covered with an iron plate CC, which plate is notched, and acts as ratches on each side the machine. On these slide at liberty another wooden frame or carriage BB, and at the corners, marked 1, 2, 3, 4, there are four friction-rollers, to give freedom to its working on the plates. GG are two palls, fixed on the carriage BB, shown at H. The spring J makes the palls keep to the work and act upon the ratches CC. H is a rope, which is attached to the tails of the palls, and passes over the pulley E, and is continued to, and fastened on, the roller D, which being put in motion by the winch and wheels F, will, with equal ease and safety, either raise the carriage, or let it down. Should a rope break, the palls will immediately act and stop the carriage.

Wonders of Philosophy.—The polypus, like the fabled hydra, receives new life from the knife which is lifted to destroy it. The fly-spider lays an egg as large as itself. There are four thousand and forty-one muscles in a caterpillar. Hook discovered fourteen thousand mirrors in the eyes of a drone; and to effect the respiration of a carp, thirteen thousand three hundred arteries, vessels, veins, and bones, &c., are necessary. The body of every spider contains four little masses pierced with a multitude of imperceptible holes, each hole permitting the passage of a single thread; all the threads, to the amount of a thousand to each mass, join together, when they come out and make the single thread with which the spider spins its web; so that what we call a spider's thread consists of more than four thousand united. Lewenhoek, by means of microscopes, observed spiders no bigger than a grain of sand, who spun thread so fine that it took four thousand of them to equal in magnitude a single hair.—[London Courier.]

Horizontal Wind-Mill.—Mr. H. Rulon, of Mullica Hill, Gloucester county, New-Jersey, an ingenious and talented mechanic, has invented a Horizontal Wind-Mill, of an entire new plan. It has been pronounced by competent judges, as superior to all others: combining all their advantages, and retaining none of their imperfections. The difficulty and danger of managing wind-mills in time of hard blows and blasts, has heretofore proved an almost insuperable objection to their erection. This great defect he has entirely obviated. And from the peculiar structure and formation of the wings, the power of the wind operates a third stronger, and may be managed with the same uniformity and regularity as water mills. From the simplicity of construction and formation, it may be erected at a very trifling expense. —[Camden Nat. Rep.]

[We should be much obliged if Mr. Rulon will favor us with a drawing of his invention, accompanied by a description; and we shall have great pleasure in giving them an insertion in our pages.—Ed. M. M.]

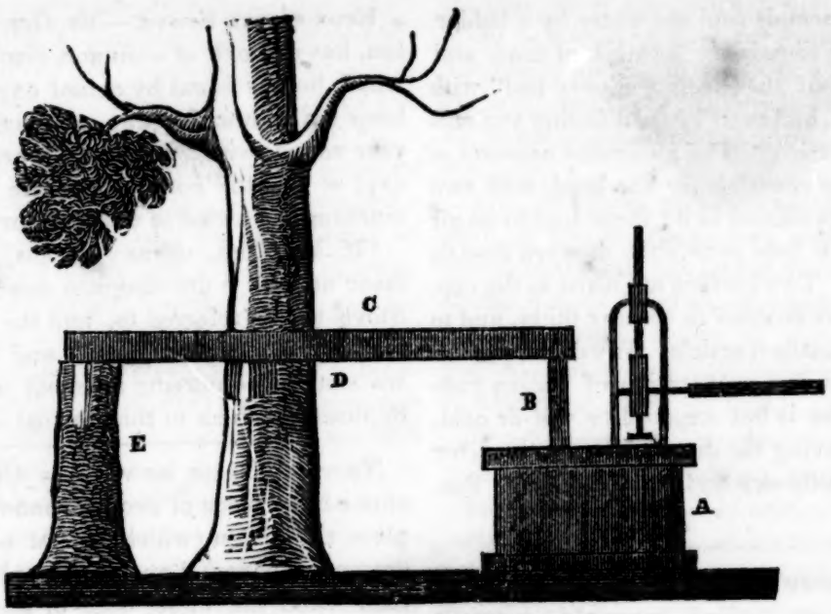
Invaluable Invention.—We on Saturday last witnessed the practical effects of a contrivance by which a pair of horses, at the option of the driver, and in an instant, are disengaged from a carriage. It is so contrived that nothing is taken from the carriage—not even the swingle trees: but the traces are separated from all these, and the horses go free, leaving the entire carriage and its fixtures, tongue and all, as if they had not been attached to it.

In all other inventions of this sort to save human life, either the fore-wheels were disengaged from the axle-trees, or the swingle-trees from the cross-bars—but in the first, the fall of the carriage would precipitate all in it out: and in the last, the horses carrying after them the swingle-trees, were not only cut, but alarmed, and for ever ruined as to all purposes of coach horses in future.

This discovery is free from all these evils, and presents to our view one of the *safest, simplest*, and most *admirable* plans that has ever been hit upon, and we doubt not that every owner of a carriage, whether private or public, will avail himself of the right to use this great and certain method of saving human life.

The carriage used and the harness were taken as they were found, without the entire preparation which the plan embraces. Yet it worked without a single impediment, to the surprise and admiration of hundreds. We have never seen a more useful invention.—[Poulson's Ad.]

[If the inventor will favor us with a more particular description of his plan, we shall have much pleasure in giving it publicity, and if he can accompany it with a drawing we shall be the more obliged.—Ed. M. M.]



Application of Bramah's Pump to the Eradication of Stumps of Trees. By F. H. [From the London Mechanics' Magazine.]

Sir,—Your correspondent, Mr. Hounds (p. 98,) inquires for a machine to render the clearing of the woods more easy to the emigrant, and seems to think something in the shape of a circular saw most likely to supply the desideratum. Now, sir, I have always understood that the axe, in the hands of a skilful woodsman, is as efficient an instrument as need be desired for the mere clearing, but that it is the stumping, or getting up the roots, which is the most difficult part of the business, and for which some new process is the most imperiously required. The usual way, I believe, is to leave the stumps in the ground until they become rotten in the course of nature, which takes several years, during which the settler has to plough round them. Those who have capital sufficient make use of machinery, set in motion by horses or oxen, to pull out the roots at once; but this process is of course out of the reach of the poorer classes of emigrants, who have very little money to spare for implements, and none for live stock. To this class, perhaps, a machine like that represented in the prefixed figure might prove of essential service. Its cost would not be very great, and its application would be particularly easy :—

A is a Bramah's pump, from its great power and simplicity the best moving force for the purpose.

B the solid piston, on which is placed one end of

C, a strong beam of timber, fitting in

D, a notch cut in the tree to be felled. The other end rests on

E, the stump of a tree, or other convenient block, near the tree operated upon. When the pump is worked, the beam C will of course be raised, and the tree must necessarily rise with it. It might perhaps be requisite to dig a little round the roots, and to cut some of the principal ones, but of course the power exerted might be increased to an immense extent, by employing a longer beam, so as to gain a very long leverage. If not used to fell, or rather to raise a growing tree by the roots, this machine might be of great service in extirpating the stumps, by means of an arrangement similar to that employed in drawing the piles of Waterloo Bridge, as described by Mr. Davy, in vol 13, page 184, of the Mechanics' Magazine.

Another correspondent, P. M., (also on page 98,) has proposed a plan for transmitting ready-made cottages to Australia. The usefulness of this may be doubted, especially when it is recollected that a wooden house, which was sent out to New South Wales at the first establishment of the colony to serve as a hospital, took *several months* in erecting at its place of destination, although it had been put together in London in a few hours! Besides, it will never pay to carry a ready-made house *more* than 10,000 miles. Yours, &c., F. H.

June 8, 1832.

New Diving Apparatus.—The Board of Admiralty lately sent down to Sheerness the invention of an ingenious apparatus, to make trial of, under the inspection of Sir J. Beresford.

The diver descends into the water by a ladder, where he can remain for a length of time, and can walk about the "ocean's oozy bed" with perfect safety, and even without feeling any suffocating sensation. The apparatus consists of a metal cap or covering for the head, with two tubes or hoses affixed to it; these lead to an air pump which is kept constantly at work during the descent. Two glasses are fitted in the cap, by which he is enabled to see any thing, and to pick up the smallest article. His dress, including the gloves, is a preparation of Indian rubber, so that he is not exposed to wet or cold, for upon removing the dress and cap, the diver appears perfectly dry and warm.—[Rep. Pat. Inv.]

On the Cause of Rain.—Every one must have noticed an obvious connexion between heat and the vapor in the atmosphere. Heat promotes evaporation, and contributes to retain the vapor when in the atmosphere, and cold precipitates or condenses the vapor. But these facts do not explain the phenomenon of rain, which is as frequently attended with an increase as with a diminution of the temperature of the atmosphere.

The late Dr. Hutton, of Edinburgh, is generally allowed to be the first person who published a correct notion of the cause of rain. (See Edin. Trans. vol. i. and ii. and Hutton's Dissertations, &c.) Without deciding whether vapor be simply expanded by heat, and diffused through the atmosphere, or chemically combined with it, he maintained from the phenomena that the quantity of vapor capable of entering into the air increases in a greater ratio than the temperature; and hence he fairly infers, that, whenever two volumes of air of different temperature are mixed together, each being previously saturated with vapor, a precipitation of a portion of vapor must ensue, in consequence of the *mean* temperature not being able to support the *mean* quantity of vapor.

The cause of rain, therefore, is now no longer an object of doubt. If two masses of air of unequal temperatures, by the ordinary currents of the winds, are intermixed, when saturated with vapor, a precipitation ensues. If the masses are under saturation, then less precipitation takes place, or none at all, according to the degree. Also, the warmer the air, the greater is the quantity of vapor precipitated in like circumstances. Hence the reason why rains are heavier in summer than winter, and in warm countries than in cold.

Economical Stove.—Mr. Orr, of Washington, has a Stove of common size in his room, which he has found by actual experiment will keep a fire burning day and night the whole year round, with one cent's worth of wood a day, at $6 the cord! The fire will require touching but twice in twenty-four hours.

[If Mr. Orr, or any of his friends, will favor us with a drawing and description of the Stove above referred to, and the name of the maker, we shall be obliged; and we conceive we shall be conferring a benefit on the public by inserting them in this journal.—Ed. M. M.]

To stain Glass of various Colors.—Procure a large piece of crown window glass, and place the design (which should be previously drawn on paper) beneath the plate of glass, then brush the upper side of the glass with gum-water, and when this is perfectly dry, it will form a surface proper for receiving the colors without danger of their spreading or running. The outlines of the design are then to be drawn with a fine pencil, in a black or blue color, and after they are dry they are to be laid on with larger pencils. After the colors are all laid on, they are to be again taken off those parts which are intended to be very light: this may be done by a goose-quill, cut like a pen without a slit. The glass must now be burned, in order to fix the colors, or to stain the glass with the colors which have been laid upon it. This operation is best performed in an assayer's furnace, the fire of which must be allowed to die away gradually, as soon as the colors are found to be perfectly fixed, otherwise the glass would become too brittle.

Observation.—The colors and effect of the picture are often very different, when taken out of the fire, from what they were when put into it: this however cannot be guarded against.

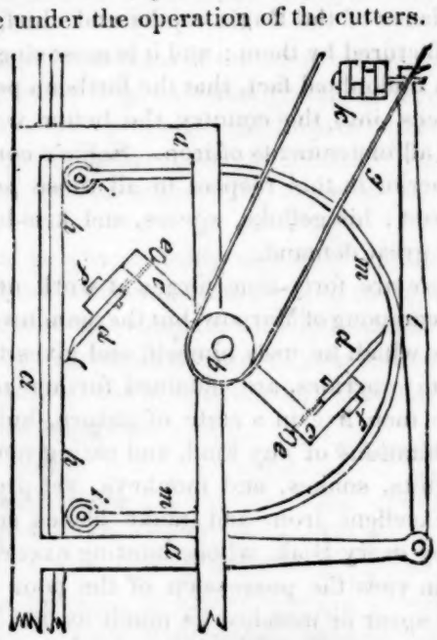
To etch Designs on Glass.—Cover the glass all over with a thin coat of bees' wax, and trace the design with an etching needle; then spread the whole over as uniformly as possible with fluor spar (Derbyshire spar) to the depth of an eighth of an inch, and when this is done, pour sulphuric acid, diluted with three times its weight of water, upon the spar. After the acid has remained upon it three or four hours it is to be poured off, and the glass washed with oil of turpentine; the etching will then appear, and the parts that were covered with the wax will have remained untouched.

Observation.—By this means glass vessels are graduated and ornamented very easily.

ENGLISH PATENT.

Patent to M. MUIR. *Engineer, for improvements in machinery for preparing Boards for Flooring, and other purposes. Granted December* 22, 1831.

In the third volume of the present series of the "Register," page 65, we have described a machine, by this patentee, for performing at once the several operations of sawing, planing, grooving, and tonguing flooring boards, and his present patent is for an addition to the same, by which the boards are reduced to a uniform thickness, and therefore completed for laying on the joists. For this purpose the boards are laid upon their faces, or planed sides, and made to pass under a set of revolving adze cutters, by which they are reduced to uniform thickness. The annexed is a sketch of the revolving adzes, where *a a a* show a cast iron frame, with a pulley, or trigger, for giving motion to the cutters *d d*, which are connected with a horizontal axis by means of the rectangular arms *c c*; *e e* are adjusting screws, to regulate the depth of cut; and *f f* are binding screws, for securing the cutters when adjusted. *g b* show a band by which the motion of the steam engine, or other first mover, is transmitted to the revolving cutters. *h h* show the board to be acted upon, and *i i* are two rollers resting upon the board, and by means of the weight *k*, the lever *l*, and the bent frame *m m*, prevent the board from rising while under the operation of the cutters.



The boards are brought forward to the cutters by means of a chain passing over a drum situated where the frame is shown imperfect. From different links of the chain descend hooks, which hold the end of the board and force it forward as the drum revolves, and when the last end of the board is brought under the drum it is to be pushed forwards by the introduction of another board, and a hook from the chain applied to the farther end of that, and so on in succession, during the operation of the machine.

The favorable opinion which we formerly gave of Mr. Muir's planing machine has been completely borne out by the success of the machine, and we have every reason for believing that the patent before us will prove an important addition to his former invention.—[Reg. of Arts.]

[*From Babbage's Work on Economy of Machinery, &c.*]

ECONOMY IN MANUFACTURING, ILLUSTRATED.—Among the causes which tend to the cheap production of any article, and which require additional capital, may be mentioned the care which is taken to allow no part of the raw produce, out of which it is formed, to be absolutely wasted. An attention to this circumstance sometimes causes the union of two trades in one factory, which otherwise would naturally have been separated. An enumeration of the arts to which the horns of cattle are applicable furnishes a striking instance of this kind of economy. The tanner who has purchased the hide separates the horns, and sells them to the maker of combs and lanterns. The horn consists of two parts, an outward horny case, and an inward conical shaped substance, somewhat intermediate between indurated hair and bone. The first process consists in separating these two parts, by means of a blow against a block of wood. The horny exterior is then cut into three portions by means of a frame saw.

1. The lowest of these, next to the root of the hair, after undergoing several processes, by which it is rendered flat, is made into combs.

2. The middle of the horn, after being flattened by heat, and its transparency improved by oil, is split into thin layers, and forms a substitute for glass in lanterns of the commonest kind.

3. The tip of the horn is used by the makers of knife handles, and of the tops of whips, and for other similar purposes.

4. The interior, or core of the horn, is boiled down in water. A large quantity of fat rises to the surface; this is put aside, and sold to the makers of yellow soap.

5. The liquid itself is used as a kind of glue, and is purchased by the cloth dressers for stiffening.

6. The bony substance, which remains be-

hind, is then sent to the mill, and, being ground down, is sold to the farmers for manure.

Besides these various purposes to which the different parts of the horn are applied, the clippings which arise in comb making are sold to the farmer for manure, at about one shilling a bushel. In the first year after they are spread over the soil they have comparatively little effect, but during the next four or five, their efficiency is considerable. The shavings which form the refuse of the lantern maker are of a much thinner texture: a few of them are cut into various figures and painted, and used as toys; for being hygrometric, they crawl up when placed in the palm of a warm hand. But the greater part of these shavings are also sold for manure, which, from their extremely thin and divided form, produce its full effect upon the first crop.

Machine for Making Pins.—Some further reflections are suggested by the preceding analysis, but it may be convenient previously to place before the reader a brief description of a machine for making pins, invented by an American. It is highly ingenious in point of contrivance, and, in respect to its economical principles, will furnish a strong and interesting contrast with the manufacture of pins by the human hand. In this machine, a coil of brass wire is placed on an axis; one end of this wire is drawn by a pair of rollers through a small hole in a plate of steel, and is held there by forceps. As soon as the machine is put in action—

1. The forceps draws the wire on to a distance equal in length to one pin: a cutting edge of steel then descends close to the hole through which the wire entered, and severs a piece equal in length to one pin.

2. The forceps holding the wire moves on until it brings the wire into the centre of the *chuck* of a small lathe, which opens to receive it. Whilst the forceps returns to fetch another piece of wire the lathe revolves rapidly, and grinds the projecting end of the wire upon a steel mill which advances towards it.

3. After this first, or coarse pointing, the lathe stops, and another forceps takes hold of the half pointed pin, (which is instantly relieved by the opening of the *chuck*,) and conveys it to a similar *chuck* of another lathe, which receives it, and finishes the pointing on a finer steel mill.

4. This mill again stops, and another forceps removes the pointed pin into a pair of strong steel clams, having a small groove in them by which they hold the pin very firmly. A part of this groove, which terminates at that edge of the steel clams which is intended to form the head of the pin, is made conical. A small round steel punch is now driven forcibly against the end of the wire thus clamped, and the head of the pin is partially formed by pressing the wire into the conical cavity.

5. Another pair of forceps now removes the pin to another pair of clams, and the head of the pin is completed by a blow from a second punch, the end of which is slightly concave. Each pair of forcepts returns as soon as it has delivered its burthen; and thus there are always five pieces of wire at the same moment in different stages of advance towards a finished pin. The pins so formed are received into a tray, and whitened, and papered in the usual manner.

About sixty pins can thus be made by this machine in one minute; but each process occupies exactly the same time in performing.

The Iron of Borneo.—The iron found all along the coast of Borneo is of a very superior quality, which every person must know who has visited Pontiana or Sambas. At Bangermassing, it is, however, much superior; they have a method of working it which precludes all necessity of purchasing European steel. But the best iron of Bangermassing is not equal to that worked by the rudest Diak; all the best kris-blades of the Bugis rajahs and chiefs are manufactured by them; and it is most singular, but an undoubted fact, that the farther a person advances into the country the better will be found all instruments of iron. Seljie's country is superior in this respect to all those nearer the coast; his golloks, spears, and kris-blades are in great demand.

There are forty-nine forges at work merely in the campong of Marpow, but the mandows and spears which he uses himself, and gives to his favorite warriors, are obtained further north. Those men live in a state of nature, building no habitations of any kind, and eating nothing but fruits, snakes, and monkeys, yet procure this excellent iron, and make blades sought after by every Diak, whose hunting excursions have in view the possession of the poor creature's spear or mandow as much as his head, strange as it may sound.

Instruments made of it will cut through overwrought and common steel with ease. We have seen penknives shaved to pieces with them by way of experiment; and one day a wager of a few rupees having been made with Seljie, that

he would not cut through an old musket barrel, he without hesitation put the end of it upon a block of wood and chopped it to pieces without in the least turning the edge of the mandow.

In the sultan of Cotti's house there are three muskets, formerly belonging to Major Mullen's detachment, which are each cut more than half through in several places by the mandows of the party which destroyed them. This circumstance being mentioned to Seljie, he laughed, and said that the mandows used on that occasion were not made of his iron, otherwise the barrels would have been cut through at every stroke.—[Abridged from an article in the Singapore Chronicle.]

Remarks on Mr. White's experiments on the cohesion of cements, with a tabular view of their results, reduced to a common scale. By B. Bevan, Esq. [From the Philosophical Magazine and Journal.]

Gentlemen,—The papers on cements, communicated by Mr. White, and published in the Philosophical Magazine and Annals, N. S. vol. xi. pp. 264 and 333, are of considerable importance on account of the numerous facts they contain. They enable the architect and builder to know where, and in what manner, to apply the different kinds of cement, and the degree of stress which may safely be laid upon them.

A careful perusal of the numeral results will point out several common errors, in respect to the cohesive properties of Roman cement and pozzolano, under different modifications, and under various degrees of exposure to moisture.

And as you probably may be of opinion that an abstract of the results given in those papers, reduced to one common scale in a tabular form, may be acceptable to some of your readers, and save much time to individuals, I take the liberty of sending one.

		Cohesive strength per inch. lbs.	Mean.
Cement in bars,			
Age 6 days,	1 dry	474	
	2 variable	360	356
	3 wet	234	
Age 47 days,	1 dry	516	
	2 variable	564	
	3 wet	270	
Age 94 days,	1 dry	210	
	2 variable	618	380
	3 wet	312	
Age 187 days,	1 dry	534	
	2 variable	708	519
	3 wet	336	
Mean of the dry			433
	variable		562
	wet		288
With salt water,			924
With 51 per cent. of water,			330
With 64 do.	do.		215
3 parts cement, 2 parts sand,			456
1 part cement, 1 part brickdust,			312
Bricks,			
3 pts. cement, 2 sand, 6 months,			375
3 do.	2 ?		362
All cement,	9 months,		360
Paving bricks, best sort,			253
Do.	seconds,		194
Common building brick, London,*			43
Common bricks, Soho,			412
Brick cylinders,			
Laid in cement,			27
Laid in cement and sand,			58
————			48
————			53

Brick piers,			
Laid in cement, 2 parts, rough lime, 1 pt. sand, 1½ parts,	1 month		4¼
pozzolano, 3 pts docking lime, 1 p	6 weeks		7
pure cement,			21
pozzolano, 1 ; stone lime, 1,			8¼
Atkinson's cement, 1 ; sand, 1,			25¼
ditto,			49¼
cement, 4 ; lime, 1,			17

The apparent deficiency of strength in these experiments probably arose from the position of the resultant and strain in being on one side, instead of in the middle of the piers.

Force required to crush, per square inch.

P. 337.	lbs.
A 14 inch brick pier, laid in cement,	470
Pozzolano, 3 parts ; ground lime, 1,	296
Atkinson's cement, 1 ; sand, 1,	410
Pozzolano, 4 ; lime, 1,	638
Ditto, 3 ; Dorking lime, 1,	600
Stone-lime, 1 ; sand, 3,	500
Portland stone pier,	2300

Yours, truly, B. Bevan.

P. S.—From the disproportions between the cohesive strength of pure cement and cement used in brick work, it is desirable that further experiments should be made on this subject.

---

* Stowbridge fire bricks have a strength of 790 lbs. per square inch. The bricks I used at Greenwich Well were made at Fenny Stratford, and would support 715 lbs. per square inch; equal to the strength of Yorkshire stone.

A new Material of Building has been employed in a wall which Mr. W. Ranger is now erecting for Mr. Lawrence Peel, behind that gentleman's mansion in Kemp Town, that will, without doubt, come into general use, and pro-

bably in the end supersede brick throughout the country. In appearance it has all the nobleness of stone, and its durability is equal, while its cost is in the proportion of only one to three. The principal ingredient is the grey lime of our own Downs, which is manufactured into a concrete mass. It is impervious to wet, so that houses built of this material must, of course, be warmer than at present; and it has this further advantage, that it can not only be moulded into stones of any shape or size, but may even be worked up on the spot so as to form one solid unbroken mass.—[Brighton Gazette.]

[*From the London Mechanics' Magazine.*]

PROOF OF THE ADVANTAGES OF LONG LEVERS IN LOCOMOTIVE MACHINES.—Sir: I had written separate replies to most of the opponents of my theory of locomotion; but, finding in their papers so much truth intimately mingled with so much error, I perceived my remarks were, and must be, far more extended than I wished them to be, or than your pages would reasonably permit. I therefore thought all useful purposes would be answered by sending the following conclusions, arrived at by the various reasonings of your correspondents, and by multiplied experiments of my own, by which they will see how far I am convinced of the truth of what they have advanced, and how far I retain my original opinions: such are the beneficial uses of discussion.

Conclusions.—1. That my 8th proposition, vol. 15, page 44, is virtually admitted, and that the fulcrum of locomotion is the ground. This renders it unnecessary to send the promised drawing of a carriage, without spoke or axle, and here I particularly wish to give part of my intended answer to S. Y., page 94. He says, "the difficulty of obtaining those outward abutments" is the great obstacle. I agree with him, that it is one great difficulty, that is to obtain abutments of sufficient hold or strength; he wants an iron cog rail, to use a great force at, with a short lever; but that a common road will never furnish; the abutments must be taken as they are; and by using a long lever and light power in emergencies, those abutments may be made, in all useful cases, sufficient; instance, a ton-weight, balanced on an equal armed lever, will require another ton, therefore the fulcrum or abutment will carry and be forced by 40 cwt.; but if you balance the ton on a 20 to 1 armed lever, the fulcrum will only be forced by 21 cwt. and may hold when it would not with 40 cwt. This I consider a good and true illustration, in some cases, of the force of long levers on my locomotive fulcrums, and of the advantage of such levers.

2. That my 9th proposition is not to be considered as an universal one, because a locomotive machine may be worked by levers of the second order, as well as by those of the first order, as is exemplified below.

3. That an open-topped steam cylinder has a different effect on a locomotive machine to a close-topped cylinder is again different in its power of locomotive action to a horizontal one, and that the action of spur or bevil gearing is different in effect to the action of cranks of the same radius.

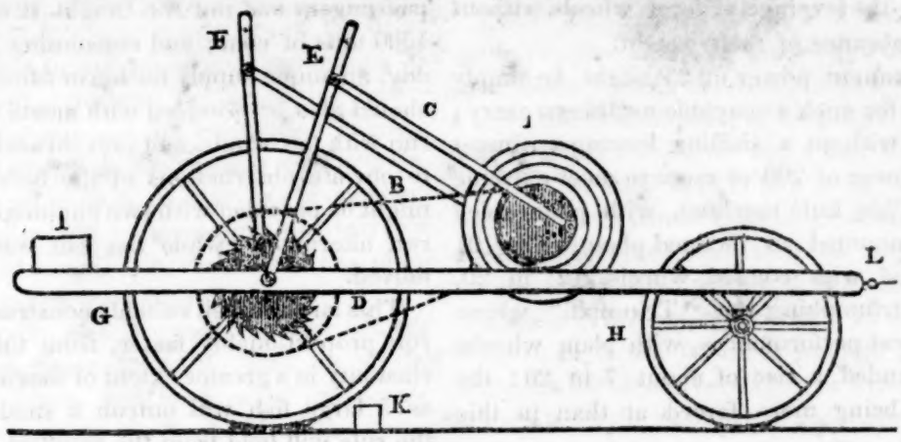
4. That my 5th proposition is only partially correct, being right in some cases and wrong in others; consequently, that the theory of the application of power in various ways to a locomotive machine must be divided into two or more classes, each class embracing two or more orders, which classification I shall hereafter describe. The following leading principle, mentioned vol. 15, page 150, I think includes all classes: "There cannot be advancing motion produced by any machine, animate or inanimate, unless the power attempting to produce such motion can ply against an abutment or fulcrum that is either immoveable or much more slowly moving than such power of advancing motion."

5. That a short lever can effect on cog-rails, that which it is impossible for it to effect on a plain road with plain wheels.

6. (And which is the burden of all from the beginning.) That gearing of long radius will practically pass a locomotive machine with plain wheels through difficulties which gearing of short radius cannot do.

Any remarks upon these conclusions I shall be happy to peruse, and to reply to; and if I have not heretofore written under such equanimity of temper as some of your correspondents, it has arisen more from playfulness of spirit than from any unbecoming feeling, but I will restrain it in future.

I have long been trying to work a locomotive machine by a lever longer in its power-arm than the radius of the wheel, and am happy to send you particulars of a successful experiment to that effect. The singular motion of a pin on the rim of a coach wheel has often been remarked, and the nature of the cycloidal curve explained, but until the promulgation of the wheelbarrow problem, vol. 14, page 191, I do



not know that the locomotive advantages of this curve have ever been known or applied. In making a complete revolution of a locomotive wheel, the point that first touched the ground moves forward the same distance that the axle does (see page 8); but in moving this distance, it first proceeds very slowly, then very rapidly, then slowly again, so that the top of a wheel is always advancing very much faster than the bottom. In makingonly one-eighth of a revolution, the top starting point of the wheel will have advanced more than 12 times as far as the bottom starting point—consequently, by constantly making the top of the wheel the place of the power, and constantly making the bottom of the wheel (as it is) the place of the fulcrum, and the axle the place of the locomotive resistance (as in a second class lever), a small power may be made to have a great effect, as in the wheelbarrow problem, *especially if the top radius of the wheel can be lengthened without lengthening the bottom.* This, as the following experiment shows, may be done, and in theory may be done without limit, so that a power (abating friction), however small, may be made to locomote a weight, however large, over an obstacle of any definite height. Can Science do more for locomotion than this?

[*See engraving at the head of the page.*]

Let A be a locomotive power (I used a strong spiral spring) turning a wheel carrying two or more, if needful, pins, BC, two or more connecting rods working on these pins.

D, two or more ratchet wheels fastened to the axle of the carriage wheels, E, F, two or more main levers pulling round the ratchet wheels one way only, and slipping the other way.

G, H, wheels of the locomotive carriage.

I, a balance weight to keep plenty of pressure on the ground and obstacle K.

N. B.—This weight must be particularly attended to, if any one repeats the experiment.

Now, the motion of the spring wheel, A, alternates the main levers, and propels the carriage, something like the little predomotive vehicles described in Treatises on Mechanics, but on quite a different principle as regards situation and leverage. The longer these main levers are the less power will be requisite to effect the motion, and any obstacle can be locomoted over with plain wheels that the wheels will hold on without slipping. A carriage might be worked on good ground, with only the common power requisite for a level road, by any ordinary gearing (represented by the dotted lines,) and a pair or more of these levers, occasionally used, would take the carriage through any difficulty.

I placed the machine on a level plane, with an obstacle K under the power wheel equal to one-tenth the distance of the wheel. I then tried how much statumotive, or horse power, at L, must be exerted horizontally to draw the machine over the obstacle, and found it, say, 56; I next wound up the spring until it indicated a power equal to 56, and when the connecting rods, B C, were fastened to the levers E F, near to the full radius of the wheel, this power of 56 also locomoted the machine over the obstacle. Again I shifted the rods until they were attached to the levers, E F, considerably beyond the rim of the wheel, when a power on the spring, equal to 25, effected the locomotion over the obstacle, and I believe I could have lengthened the levers until a power of 5 or less, or even a fraction, would have effected the same locomotion (slower, of course.) Next I attached the rods to a short radius on the levers, when it required a power on the spring equal to 200 to effect locomotion over the obstacle.

This I consider a very successful experiment; forcibly showing the power and practical advantages of long levers in surmounting locomotive difficulties—as in extreme cases, we

can have the leverage of large wheels without the incumbrance of their weight.

A permanent power of 25 might be amply sufficient for such a machine as this to carry; whereas, without a shifting leverage, it must carry a power of 200 or more to meet extreme cases. This little machine, with plain soled wheels, mounted an inclined plane, rising 9½ in 20, and with cogged wheels, 12¼ in 20, thus out-triumphing the "Triumph," whose model's best performances, with plain wheels, only ascended a rise of about 7 in 20! the abutment being more forced at than in this machine.

I cannot become coach proprietor or common carrier; but I hope Mr. Gurney will be induced to try the effect of occasional long levers—he need not then fear any hill or newly made road that horses can travel upon. As I before stated, I see no obstacle to the success of steam carriages on common roads but their vast weight, in proportion to their power; and this obstacle I know not how to overcome without abatement of speed.

Yours, &c. SAXULA.

December 12, 1831.

[*For the American Mechanics' Magazine.*]

NASHVILLE, Tenn. January 23, 1833.

NAVIGATION OF THE OCEAN BY STEAM.—I am confident that in a short time the Atlantic will be subjected to safe, cheap, and regular steam navigation. The principal objections are, want of fuel for a long voyage, roughness of the waves, and obstruction of the boilers by salt water. These difficulties will be obviated by the plan I propose.

It has been ascertained from scientific measurement that the waves of the Atlantic never rise in time of storms more than twenty-four feet high; and the breadth nearly double the elevation. To overcome waves 24 feet high by 48 wide, it is necessary to build a large vessel, near the size of our seventy-four gun ships, 300 feet long and 70 wide. The largest steamboat was lately built at Pittsburg, the Mediterranean, 196 feet long, and boiler of 400 horse power. A boat of 300 feet would ride across six waves, as on joists, equally sustained; and the width would fill the space between waves, and prevent rolling. The engines, one on each side, of 500 horse power, and 48 feet diameter of wheel, would have a slow stroke, suitable to take hold passing from wave to wave at twelve miles per hour; and cross the Atlantic, 3000 miles, in ten or eleven days. Built for passengers and not for freight, it would carry 1500 tons of coal; and consuming 100 tons a day, an ample supply for ten or fifteen days. It should also be provided with masts and sails to run with fair winds, and prevent accidents; and to obviate obstructions of the boilers by salt, might be provided with two engines on a side, to run alternately, while the salt was being removed.

This large vessel, suitably constructed, would run proportionably faster, from the increased elasticity in a greater extent of moving medium, as a large fish will outrun a small one; and the rule will hold from the smallest to the largest moving body. This size would conveniently carry one thousand cabin passengers, and reduce the price (in the present ship packets, $135) to $100 a passenger, would be $100,000 a trip; and crossing and recrossing in a month, would be $200,000; and in a year, $2,400,000. A seventy-four, manned with 1000 men and ready for a cruise, costs $1,000,000. This steamboat could not cost more than half as much; perhaps the cost and expense for a year's running would not exceed that sum—if so, the profit would be $1,400,000. But in these details I have by no means correct data, and only give a conjecture for the investigation of experimental men.

To test the plan, a voyage could be first made from New-York or some eastern city, touching at the Chesapeake, Charleston, Havana, and New-Orleans. If it succeeded, then Europe would be brought relatively three or four times nearer to us; and there would be no lack of passengers and competition. For who would not at such a cheap cost visit England, France and Germany; or even make a fashionable trip of a few days up the classic Mediterranean, to Italy, Greece, Egypt, and Palestine, where civilization, language, laws, and religion, had their origin.

The Pacific Ocean would be the most easy to navigate, even with our common steamboats, if they were large enough to carry fuel. From the mouth of Columbia river, by the Sandwich islands, (a coal deposit,) to China, the voyage might be made over the calm unruffled Pacific, in twenty days or less. A steamboat ascended the Missouri last season 2000 miles; and they can go within less than 200 miles of the navigation of the Columbia river. A railroad across, by this route, and Asia would be relatively nearer to us than Europe is at present. What a theatre this for the enterprize of our countrymen! The steam engine is the

most important modern invention. As a stationary power it forms a new era in the arts. Its application to navigation and locomotion is making great progress in facilitating intercourse. The success of locomotive engines on common and M'Adam roads is now certain, and their rapid motion on railroads is wonderful. In navigation, in stemming the torrents of rivers, the steamboats, those immense moving hotels, excite our admiration.

This portable elastic power is now felt, or soon will be, throughout the land, on all the rivers, and lakes, and borders of the ocean, from the Atlantic to the Rocky Mountains and the Pacific, carrying in its train the blessings of civilization, intelligence, and science, till the lonely and remote savage wilderness will resound with the hum of population.

The ocean, which covers three-fourths of the earth, and separates nations and continents by boisterous and dangerous waves, the sport of the capricious winds, will soon yield its listless force to the all-subduing power of steam, guided by science.

Intending, when I had more accurate information and leisure, to make a communication, my attention was called to the subject by the British journals. In the London Quarterly for March last, page 42, it is claimed as a most important point of national superiority of Britain over our country, that they navigate the ocean by steam; while our steam navigation, confined to the rivers, will not fit our *Steamermen*, as the reviewer says, to navigate the ocean. I am not sure that our tide-water steam navigation, in Long Island Sound, the Chesapeake, and the Lakes, and along the Atlantic from Maine to Florida, and in the Gulf of Mexico, is not at least three times the extent of their *Channels* of the same kind. I read a statement with much pleasure in a late eastern paper, that, on the first instant, the steamboat David Brown made the passage from New-York to Charleston, each way, in four days running. An extract from the United Service Journal in your journal of the 5th inst. on "Steam Vessels of War," shews what high importance is attached to that subject in England.

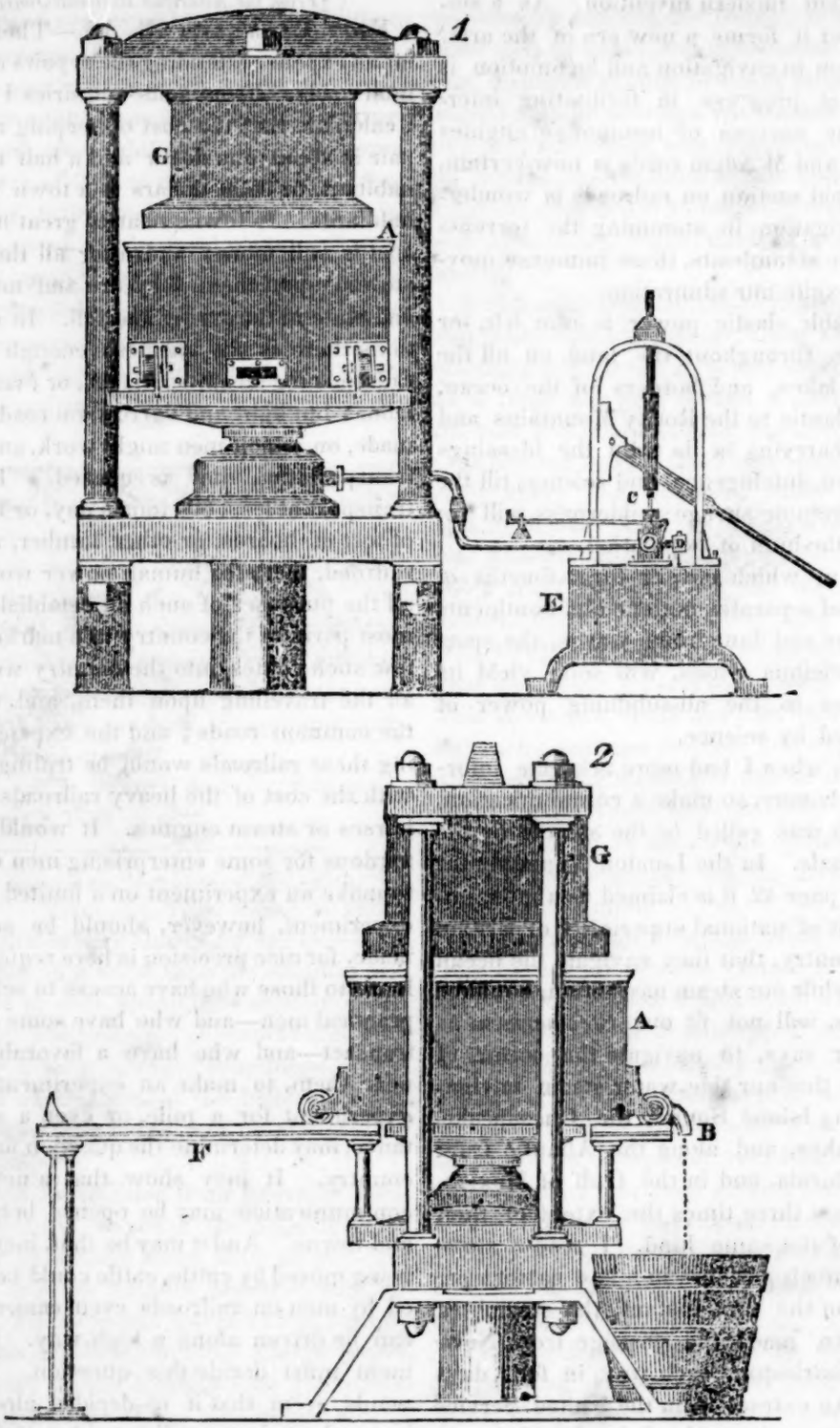
It should never be laid as a reproach to our country that any foreign nation outstrips us in a species of navigation which our country justly claims the honor of having originated; and which at no distant day is destined to change the mode of warfare on the ocean.

J. McC.

[*From the American Railroad Journal.*]

FOOT RAILROADS, No. III.—There is enormous expense attending the repairs of our common roads. From some inquiries I have made I calculate that the cost of keeping roads in repair is about one dollar and a half to every inhabitant, or 3000 dollars to a town of 2000 inhabitants. In towns near to great markets the cost is still more; and after all the labor bestowed upon them, they are and must be in a bad state in the spring and fall. In most directions there is not business enough to sustain railroads for steam-carriages, or even for horse labor; but light and narrow railroads might be made, on which men might work, and do all the transportation that is needed. They could transport at least 600 tons a day, or 180 millions of feet of boards, or other lumber, a year. A railroad, then, for human power would answer all the purposes of such an establishment from most parts of the country to a market town. A few such routes into the country would collect all the travelling upon them, and would save the common roads; and the expense of erecting these railroads would be trifling compared with the cost of the heavy railroads formed for horses or steam engines. It would not be hazardous for some enterprising men of business to make an experiment on a limited scale. The experiment, however, should be scientifically made, for nice precision is here required. It belongs to those who have access to scientific and practical men—and who have some business to transact—and who have a favorable location near them, to make an experiment. And an experiment for a mile, or even a shorter distance, may determine the question for the whole country. It may show that a new mode of communication may be opened between cities and towns. And it may be that, instead of men being moved by cattle, cattle could be transported by men on railroads even easier than they can be driven along a high-way. But experiment must decide this question. And yet it would seem that it is decided already. We know that a horse will move ten tons on a level railroad; and we know that a man has about the seventh part the strength of a horse—and we know that he can easily move at the rate of two miles an hour; and we might set it down as a decided point, that a man can move on a level railroad so great a load that it would be a public convenience to have railroads for the application of human strength for purposes of trade.

PUBLICOLA.



[*From the London Mechanics' Magazine.*]

RUSSELL'S HYDRAULIC PRESS.—We see no reason to doubt that this press of Mr. Russell's is as applicable to the expression of the juice of apples and pears, as to any of the other purposes to which it has been so successfully applied. Neither can we refuse to acknowledge that it is, in point of simplicity and probable efficiency, superior to any thing of the kind which has yet appeared in our pages. Our Devonshire and Hertfordshire friends must feel obliged to Mr. Russell for making this description of it public. We have seen a sugar apparatus fixed on this plan, in which there are two boxes running alternately on the railway, so that the sugar in one box is submitted to the action of the press, while the contents of the other are removed, and a fresh charge put in, ready to

wheel into the press as soon as it is at liberty; by this means nearly double the usual quantity of work is done in the same time.—[Editor Mechanics' Magazine.]

Sir,—Seeing in No. 438, of the Mechanics' Magazine, an engraving and description of an Hydraulic Cider Press, with what appears to me a complex apparatus to work it; and having had longer practical experience in the manufacture of hydraulic presses than I believe any individual in existence, I am induced to send you a drawing of an apparatus of this sort, which I have lately fixed at the Refuge for the Destitute, for the purpose of pressing the rinse water from the linen, woollen, and other articles, washed at that establishment, instead of wringing; and which is, of course, equally applicable in all cases where similar pressure is required.

Fig. 1 is a front elevation of the press, without its railways.

Fig. 2 is a side elevation, with the addition of the railway.

The squeezing box A has a perforated lining and bottom, through which the water passes, and runs off at a spout B at the back of the box. The diameter of the working piston of this press is four inches, that of the injecting pump C is one inch diameter, and the power of this press on the article submitted is upwards of 30 tons. If the piston of the injecting pump were one half an inch in diameter instead of one inch, the power would be increased fourfold, that is, 120 tons pressure on the articles submitted, with the same labor at the pump. When the linen, &c. is sufficiently pressed, that is, almost dry, the pressing box is lowered down, by opening the discharging valve D, on which the water returns back to the cistern E, on which the pump is fixed. The squeezing box is then drawn out on the railways F, emptied, refilled, and wheeled back for a second charge, and so on. I should have observed, that the mallet G, which is fixed to the head of the press, enters the box, and is made to fit nearly.

Having made and erected many presses of this description, for expressing the oil from various seeds, the molasses from sugar, &c. their power varying from 500 to 1000 tons pressure, I take leave to ask your opinion whether a press so constructed and shown in the drawing accompanying this communication, is or is not as applicable to pressing apples for cider, pears for perry, or any other fruit, in a superior manner to the methods which have already appeared in the Mechanics' Magazine?

Should you be of opinion that it is superior, you will probably be inclined to give it a place in your truly useful work.

Yours, &c. W. Russell.

Improved Method of Using Wheel-Drags. By W. Baddeley. [From the London Mechanics' Magazine.]

Passing down Ludgate-hill the other evening, I noticed a very heavily laden west-country waggon going down the hill with one of the wheels locked; the consequenee of which was, that the friction of the wheel upon the stones caused the evolution of considerable heat, which dried up the road in the track of the wheel, and at length produced a charring of the fellies, as was shown by the escaping of small quantities of smoke, accompanied with a strong smell of burning wood. On reaching the bottom of the hill, I went up to the waggon and found that it was furnished with a proper shoe or drag, but that the driver chose to *lock* the wheel in preference to using the drag. The reason appeared to be, that the former was the *easier* method; for if the shoe had been used, it would have been necessary to *back* the waggon out of it, whereas the locking chain was disengaged in an instant, by simply striking off a ring.

Few persons are perhaps aware of the extent to which wheels are continually injured by this practice; first, by the actual wear of the iron tire; and, secondly, by the mischievous effects of the heat upon the wooden fellies. I have repeatedly observed on Ludgate and Holborn hills, and other places, both in town and country, that unfortunately this is a regular practice, partly arising from laziness, and in part from the real difficulty of backing a loaded vehicle out of the drag.

It has therefore occurred to me, that a very simple remedy may be provided for this evil, by rendering the use of the shoe *as convenient* as the locking-chain. And this may be done in several ways: thus, for instance, by using a drag-chain of such a length as to permit the wheel to roll off it, and to take it up short enough to carry the wheel, when it is to be dragged by the same simple fastening at present used for the locking chain; viz. a ring sliding on a bent pin. In this way the drag may be used, and when the vehicle reaches the bottom of the hill it may be instantly and easily disen-

gaged, and when the wheel has rolled off may be hooked up out of the way. Or the shoe may be permanently fixed by a chain behind the wheel, and connected with the chain-drag, when required, in the way before mentioned; when done with, it may be disengaged from the drag-chain and replaced behind the wheel.

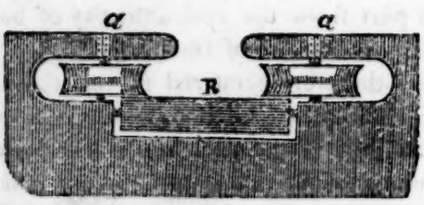
[*From the London Mechanics' Magazine.*]

Domestic Self-Acting Pump.—Sir: I am desirous of knowing whether any method has been used to apply the force of a small stream of water, having a fall of about 60 or 70 feet, by hydraulic pressure to raise a large portion a less distance. I want such a force to produce power by raising a portion of water about six or eight feet in height, into a water wheel, by a stream about 300 yards distance, having a fall as above. It will be seen from the subjoined, from the Imperial Magazine, that such a method has been tried on a small scale with success.

I remain, Sir, yours, respectfully,

A. B. C.

"That such a pump is perfectly applicable to all domestic purposes is proved by the fact of a very small one having continued working for three months without being touched, raising about two tons of water in 24 hours.; it acts entirely without friction, and by its means, the rain water collected at the top of the house will pump up a corresponding quantity of water from a well as deep as the house is high. Its principle depends upon the alternate filling and emptying of four reservoirs with air and water by means of pipes and valves: invented by Jas. Hunter, Esq. of Thurston, in Scotland—the principle of which is to raise water above the original reservoir by the descent of a certain portion of it."



[*From the London Mechanics' Magazine.*]

Improved Leading Blocks.—On examining some "leading blocks," as they are technically called, a short time since, I was struck with the appearances which many of them presented. In some, the pulley had set fast, and one side had been cut into by the rope, while in all, the way between the pulley was cut into deep groves; evidently showing the existence of great mechanical disadvantage, where the reverse would have been highly desirable.

It occurred to me at the time, that a little addition would make a great improvement in this useful machine; and I send a sketch of a method of construction that would be found very much superior to those at present employed.

The prefixed sketch represents the side of a ship, or dock, &c., &c.; *a a* are two gun-metal sheaves, turning on iron axles, and having more end play than is usual. The sheaves rest upon a metal roller R, which runs freely upon an iron axis.

The roller should be closed in, about half-way up, both on the outside and within—[omitted in the sketch for the sake of distinctness, nor is it absolutely necessary.] The framing of the block should be lined with iron, and the whole kept well greased, to reduce the friction and prevent corrosion. With this form of block, the friction, and consequently the labor, as well as the wear and tear of ropes, would be greatly reduced. For, if the rope happened not to run against either of the sheaves, it would still work upon the roller, where motion would be almost as free. If the rope took into a sheave, that and the roller would turn together; the other sheave would be at liberty to turn with the roller, the friction between them most likely being sufficient to communicate motion.

The increased efficiency and durability of these blocks would amply repay the additional expenses of construction.

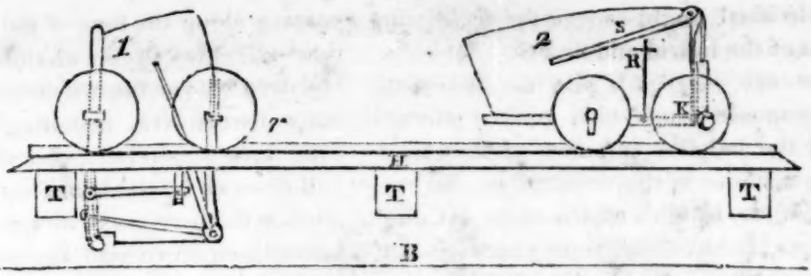
Yours, respectfully,

W. Baddeley.

London, Sept. 27, 1832.

[*From the London Mechanics' Magazine.*]

Improved Excavator's Waggon.—Sir: The accompanying sketches represent an improved sort of waggon, which was used for removing the earth at the excavation of the new entrance to the London Docks. It is a well known fact, that if clay is mixed with water and a little sand, it forms so compact and cohesive a mass, that, when carted to a distance of two or three hundred yards, it is next to impossible to uncart it without the help of pickaxe and shovel. The soil to be excavated in the present instance being very much of this description, it was the general opinion that the ordinary kind of excavator's waggon would be of little use; and being in the employment of the contractor for the work, I therefore set about contriving such an alteration in the construction as might meet the difficulty of the case. After several trials, with



different models, the one of which I now send you a description was found the most suitable. We had a good many waggons constructed on this plan; and I was very happy to find, that when the mode of using them came to be understood by the workmen, they answered our purpose admirably.

Description.—Fig. 1 is a side-view of the waggon when emptying. B, shows the line of the barge at high-water. T T T, are whole timbers. H, are half-timbers on each side of the waggon to secure the iron rail, *r*. The distance from T T, and also between the rails, are left open, to allow the tail of the waggon to drop through, as in fig. 1.

Fig. 2 shows the method of securing the tail-board at top and bottom. At J is a joint, to allow the wheels to run out, and at K a catch to secure the axle; *s*, is a strap, bolted to the side to secure the tail-board at the top.

The course followed on emptying the waggons was to push them forward to one of the timbers, as at T, and then to allow the bottom to slide down the timber gently. A man on each side then pulled up the rods, as at R, which lowered the catch K, when immediately the wheels went out, down went the waggon, and the earth dropped out. Nine times out of ten the clayey mass went down into the barge as solid as if it never had been dug. I had almost forgotten to add, that the waggons were about 4 inches wider at the tail than at the head. The drawings show the axles bent, but they were not all so: the more bent, however, the axles are, the more easily the waggons are managed. Yours, &c.

J. Walker.

Great Canal of Goetha.—This magnificent water-line, which passes through the heart of Sweden, and unites the North Sea and the Baltic, was opened with great solemnities on the 26th of September last. It will admit vessels drawing nine feet and a half water, and two and twenty feet in width; and they may make the passage into the Baltic in eight days, with the aid of steamboats across the lakes which occur on its line. It has been two and twenty years in construction, and cost rather more than 10,430,000 dollars (£1,285,000), of which 6,378,334 dollars were contributed by the state.—[Athenæum.]

Application of Projectiles to Rescuing from Fire. [From the London Mechanics' Magazine.

We extract from the "Supplement" alluded to in the article on "Mr. Murray's Plan of Instantaneous Communication with Stranded Vessels," (see page 39,) the following proposition for the application of Mr. Murray's pistol and arrow to the purposes of a fire-escape:

"I have already particularly referred to the application of the arrow and line to the instantaneous formation of fire, and it has been mentioned that the cord projected over a building was found quite sufficient to draw a rope over the roof. The suggestion was to make it thus effective for an extended rope ladder, which might be instantaneously formed on both sides of the building. The parallel ropes employed in the formation of the rope ladder must needs be kept separate by bars of wood alternating with rope, in order to prevent approach; and a single rope would suffice, there being steps attached to the side like the stirrup, the footstep having its base formed of wood, which would thus preserve an open space; the rope might be either projected at once over the roof and fastened on the opposite side, or the arrow be fired into one of the highest windows, or wherever required; to the top of the rope attached to the line might be fastened a lantern, to direct proceedings; a hammer and staple with a tally, instructing the inmates to drive the staple firmly into the floor, for fastening the rope of escape to it. For the purpose of facilitating the descent of the timid or helpless, the rope referred to might be supplied with two or more blocks, with pullies on each side, through which patent sash cord might pass for the purpose of raising or lowering a square basket, for the reception of invalids or females and children; and by the steps provided, some intrepid and enter-

prising individual might ascend for facilitating the rescue of the infirm and timid.

"There are cases wherein no fire-escape hitherto proposed would have proved effective in saving the helpless inmates. I may mention, as an instance of this description, the conflagration of Mr. Haigh's cotton-mills, at Colne-Bridge, near Huddersfield, some years ago, and in which seventeen individuals perished, as recorded in the pyramidal tomb reared over their ashes in the neighboring church-yard."

A mode of rescue similar to this of Mr. Murray's—only that a cross-bow is used instead of the pistol and arrow—has been already successfully reduced to practice by the admirable fire-establishment of Edinburgh. As the Edinburgh arrangements for the purpose are more complete than those of Mr. M., and are most of them equally adapted to the present invention, we shall here add the account given of them by Mr. Braidwood, in his excellent work on fire-engines, (Edin. 1830.)

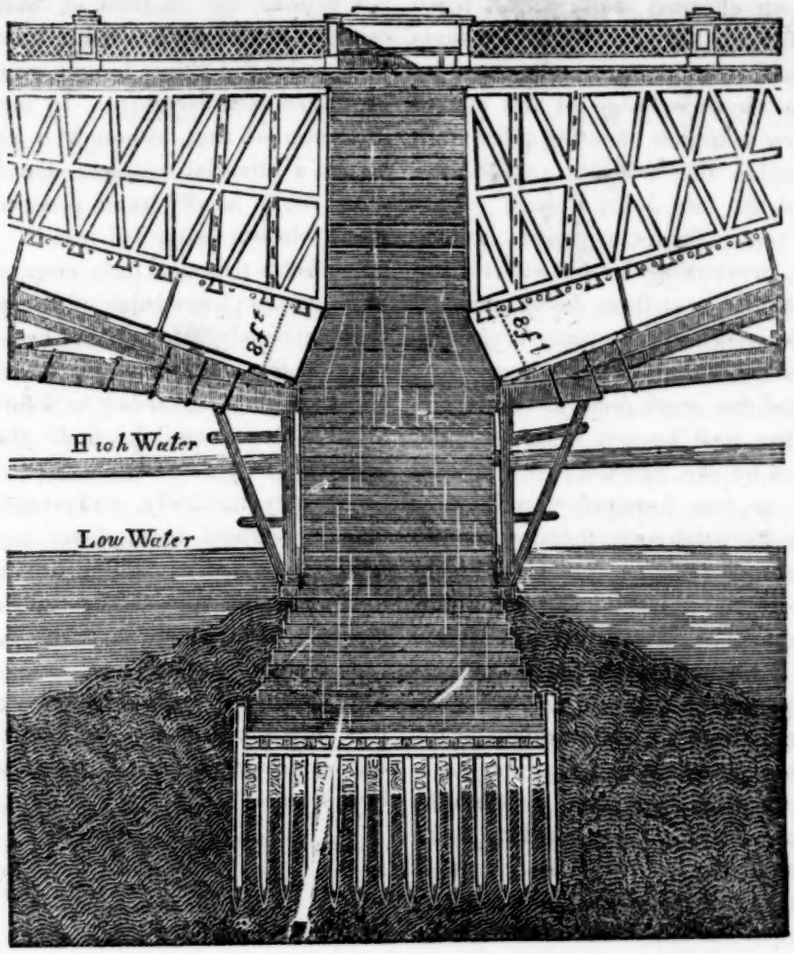
"The apparatus necessary for this fire-escape is a chain ladder, 80 feet long, a single chain or rope of the same length as the ladder, a canvass bag, a strong cross steel bow, and a fine cord of the very best workmanship and materials 130 feet long, with a lead-bullet of 3 ounce weight attached to one end, and carefully wound upon a wooden cone, 7 inches high, and 7 inches broad at the base, turned with a spiral groove, to prevent the cord slipping when wound upon it; also a small pulley with a claw attached to it, and a cord reeved through it of sufficient strength to bear the weight of the ladder. In order to prevent the sides of the ladder from collapsing, the steps are made of copper or iron tube, fastened by a piece of cord passed through the iron tube and into the links of the chain until the tube is filled. The steps thus fastened are tied to the chain with No. 14 copper wire, so that in the event of the cord being destroyed, the steps will be retained in their places by the wire. The ladder is provided with two large hooks at one end, for the purpose of fixing it to a roof, window, sole, &c. The bag is of No. 3 canvass, 3 feet wide and 4 feet deep, with cords sewed round the bottom, and meeting at the top, where they are turned over an iron thimble at each side of the mouth of the bag. The steel cross-bow is of the ordinary description, of sufficient strength to throw the lead-bullet, with the cord attached, 120 feet high. When the house from which the persons in danger are to be extricated is so situated that the firemen can get to the roof by passing along the tops of the adjoining houses, they will carry up the chain-ladder with them, and drop it over the window where the inmates show themselves, fastening the hooks at the same time securely in the roof. The firemen will descend by the ladder into the window, and putting the persons to be removed into the bag, lower them down into the street by the single chain. If the flames are issuing from the windows below, the bag when filled is easily drawn aside into the window of the adjoining house by means of a guy or guide-rope. If the house on fire stand by itself, or if access cannot be had to the roof by means of the adjoining houses, the lead-bullet with the cord attached is thrown over the house by means of the cross-bow; to this cord a stronger one is attached, and drawn over the house by means of the former; a single chain is then attached and drawn over in like manner; and to this last is attached the chain-ladder, which, on being raised to the roof, the firemen ascend and proceed as before directed."

Southwark Iron Bridge—Construction of the Bearing Piers. From a descriptive account of the Principal Bridges erected over the River Thames: By Mr. Christ. Davy, Architect. [Continued from page 9.]

The bearing piers of a bridge involve the consideration of many and widely different circumstances, and by the construction of these vital adjuncts we are enabled in some measure to foretel the stability or insecurity of the architect's design.

A bearing pier (by which term it should be understood that those piers only are meant that are *in the river*) is generally a mass of solid masonry, built from the foundation to the level, or perhaps rather above the springing stone of the arch, and of sufficient weight to resist the attempts of the arch to overturn it, or to make it slide from its position. This force is called the thrust, push, or drift of the arch. Now, some means must be employed to determine, as near as possible, the force or weight requisite to resist the drift.

"We must," says Mr. Gwilt, "consider the thrust to be resisted by the friction, which the stones, composing the pier, experience, sliding on each other. From experiments, it has been found that in some kind of stone the friction of one block moving horizontally on another $= \frac{1}{3}$ of the weight of the moving block. If we adopt this determination, the weight of the pile ought to be equal to three times the horizontal drift to produce an equilibrium."



In addition to what Mr. Gwilt has here remarked, we must bear in mind that the piers must effectually withstand such extraneous shocks as are caused by the violence of the current, or from floating bodies. The salient angles of a pier, or cutwater, act as a preventive of the dangers likely to arise from these circumstances. In large navigable rivers, such as the Thames, the circular form sometimes given to the cutwaters is preferable, from the likelihood of their being struck by heavy craft, and its allowing them to disengage with greater facility. This form, however, does not divide the waters so well. In the earlier structures, we find, from the variety of proportions exhibited in the piers, that the subject had claimed attention; but mathematical investigation had not yet been brought in aid of the practical part of Pontile Architecture. The practice of piling for the support of such a cumbrous mass of materials as the bearing piers of a bridge has been most generally observed, and as generally found to be adequate for the purpose. But of the use and abuse of piling, it will be necessary to speak. The main use of piling being for the purpose of passing from a loose to a denser soil, it is necessary that that soil should be of such density as to prevent the piles from sinking farther than they are driven in the first instance by the pile engine. From the enormous load they bear, this is most likely to be the case, should the pointed ends or feet of the piles not rest on ground of great solidity. Indeed, it has been observed in my former papers, that piling is only a mode of *searching for firm ground*, where it is either inconvenient or too expensive to barrow out or excavate the soil. There are, however, some instances (such as a bed of stiff tenacious clay) where it has been found, by experiment, that although the feet of the piles rest upon no other security than that of the clay, a pile 10 or 20 feet long, driven down, will, by the friction of its sides, have a hold of the ground nearly in proportion to its actual superficies.

It is evident, therefore, that piling, under two or three very different circumstances, may be made subservient to the effectual security of a foundation. The foundations of the bearing piers of Southwark Iron Bridge were laid in coffer-dams; but of a much larger and stronger description than those heretofore described.

PAGINATION INCORRECT

prising individual might ascend for facilitating the rescue of the infirm and timid.

"There are cases wherein no fire-escape hitherto proposed would have proved effective in saving the helpless inmates. I may mention, as an instance of this description, the conflagration of Mr. Haigh's cotton-mills, at Colne-Bridge, near Huddersfield, some years ago, and in which seventeen individuals perished, as recorded in the pyramidal tomb reared over their ashes in the neighboring church-yard."

A mode of rescue similar to this of Mr. Murray's—only that a cross-bow is used instead of the pistol and arrow—has been already successfully reduced to practice by the admirable fire-establishment of Edinburgh. As the Edinburgh arrangements for the purpose are more complete than those of Mr. M., and are most of them equally adapted to the present invention, we shall here add the account given of them by Mr. Braidwood, in his excellent work on fire-engines, (Edin. 1830.)

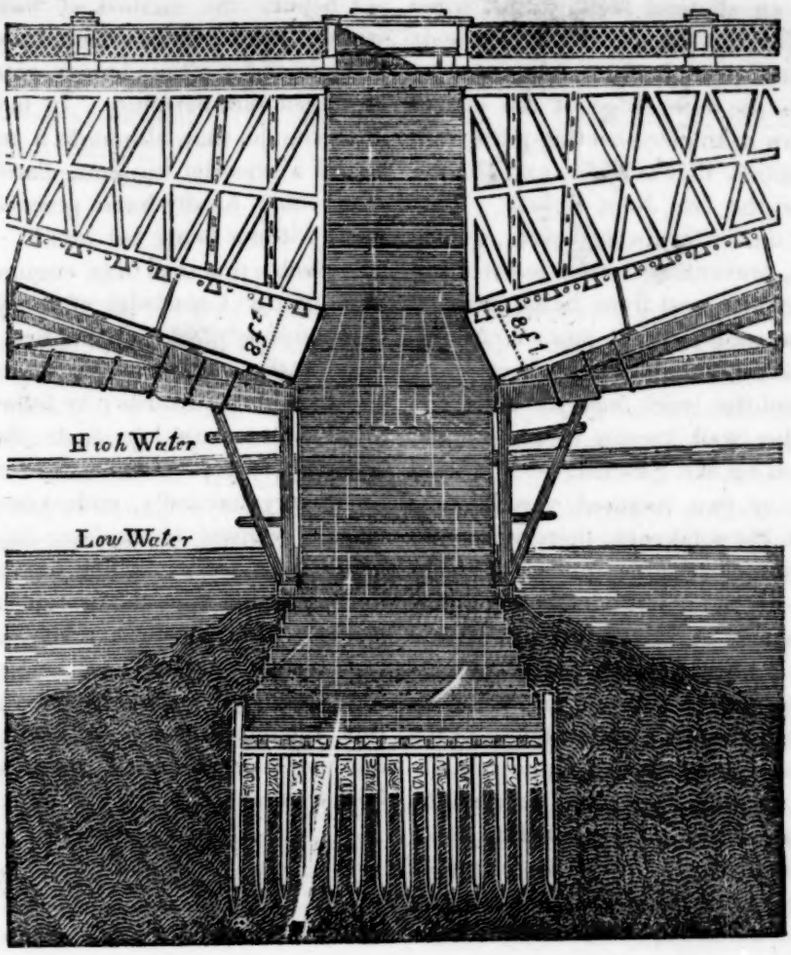
"The apparatus necessary for this fire-escape is a chain ladder, 80 feet long, a single chain or rope of the same length as the ladder, a canvass bag, a strong cross steel bow, and a fine cord of the very best workmanship and materials 130 feet long, with a lead-bullet of 3 ounce weight attached to one end, and carefully wound upon a wooden cone, 7 inches high, and 7 inches broad at the base, turned with a spiral groove, to prevent the cord slipping when wound upon it; also a small pulley with a claw attached to it, and a cord reeved through it of sufficient strength to bear the weight of the ladder. In order to prevent the sides of the ladder from collapsing, the steps are made of copper or iron tube, fastened by a piece of cord passed through the iron tube and into the links of the chain until the tube is filled. The steps thus fastened are tied to the chain with No. 14 copper wire, so that in the event of the cord being destroyed, the steps will be retained in their places by the wire. The ladder is provided with two large hooks at one end, for the purpose of fixing it to a roof, window, sole, &c. The bag is of No. 3 canvass, 3 feet wide and 4 feet deep, with cords sewed round the bottom, and meeting at the top, where they are turned over an iron thimble at each side of the mouth of the bag. The steel cross-bow is of the ordinary description, of sufficient strength to throw the lead-bullet, with the cord attached, 120 feet high. When the house from which the persons in danger are to be extricated is so situated that the firemen can get to the roof by passing along the tops of the adjoining houses, they will carry up the chain-ladder with them, and drop it over the window where the inmates show themselves, fastening the hooks at the same time securely in the roof. The firemen will descend by the ladder into the window, and putting the persons to be removed into the bag, lower them down into the street by the single chain. If the flames are issuing from the windows below, the bag when filled is easily drawn aside into the window of the adjoining house by means of a guy or guide-rope. If the house on fire stand by itself, or if access cannot be had to the roof by means of the adjoining houses, the lead-bullet with the cord attached is thrown over the house by means of the cross-bow; to this cord a stronger one is attached, and drawn over the house by means of the former; a single chain is then attached and drawn over in like manner; and to this last is attached the chain-ladder, which, on being raised to the roof, the firemen ascend and proceed as before directed."

Southwark Iron Bridge—Construction of the Bearing Piers. From a descriptive account of the Principal Bridges erected over the River Thames: By Mr. Christ. Davy, Architect. [Continued from page 9.]

The bearing piers of a bridge involve the consideration of many and widely different circumstances, and by the construction of these vital adjuncts we are enabled in some measure to foretel the stability or insecurity of the architect's design.

A bearing pier (by which term it should be understood that those piers only are meant that are *in the river*) is generally a mass of solid masonry, built from the foundation to the level, or perhaps rather above the springing stone of the arch, and of sufficient weight to resist the attempts of the arch to overturn it, or to make it slide from its position. This force is called the thrust, push, or drift of the arch. Now, some means must be employed to determine, as near as possible, the force or weight requisite to resist the drift.

"We must," says Mr. Gwilt, "consider the thrust to be resisted by the friction, which the stones, composing the pier, experience, sliding on each other. From experiments, it has been found that in some kind of stone the friction of one block moving horizontally on another $= \frac{1}{3}$ of the weight of the moving block. If we adopt this determination, the weight of the pile ought to be equal to three times the horizontal drift to produce an equilibrium."



In addition to what Mr. Gwilt has here remarked, we must bear in mind that the piers must effectually withstand such extraneous shocks as are caused by the violence of the current, or from floating bodies. The salient angles of a pier, or cutwater, act as a preventive of the dangers likely to arise from these circumstances. In large navigable rivers, such as the Thames, the circular form sometimes given to the cutwaters is preferable, from the likelihood of their being struck by heavy craft, and its allowing them to disengage with greater facility. This form, however, does not divide the waters so well. In the earlier structures, we find, from the variety of proportions exhibited in the piers, that the subject had claimed attention; but mathematical investigation had not yet been brought in aid of the practical part of Pontile Architecture. The practice of piling for the support of such a cumbrous mass of materials as the bearing piers of a bridge has been most generally observed, and as generally found to be adequate for the purpose. But of the use and abuse of piling, it will be necessary to speak. The main use of piling being for the purpose of passing from a loose to a denser soil, it is necessary that that soil should be of such density as to prevent the piles from sinking farther than they are driven in the first instance by the pile engine. From the enormous load they bear, this is most likely to be the case, should the pointed ends or feet of the piles not rest on ground of great solidity. Indeed, it has been observed in my former papers, that piling is only a mode of *searching for firm ground*, where it is either inconvenient or too expensive to barrow out or excavate the soil. There are, however, some instances (such as a bed of stiff tenacious clay) where it has been found, by experiment, that although the feet of the piles rest upon no other security than that of the clay, a pile 10 or 20 feet long, driven down, will, by the friction of its sides, have a hold of the ground nearly in proportion to its actual superficies.

It is evident, therefore, that piling, under two or three very different circumstances, may be made subservient to the effectual security of a foundation. The foundations of the bearing piers of Southwark Iron Bridge were laid in coffer-dams; but of a much larger and stronger description than those heretofore described.

They were of an eliptical form, with a triple row of piles of whole timber. Each pier rests upon a massive timber platform supported by piles. Close to the outer edge of the offsets of the pier, a row of timber sheeting-piles were driven, a precaution that at once exhibits the master mind of the late John Rennie. This uniform belt of timber forms, as it were, a close stationary dam, preventing the soft substratum upon which the piles rest from being pressed outwards by the weight of the pier: a circumstance that generally takes place where piling is employed, and the work heavy. This circumstance is also well known to miners, and is thus described by Mr. Seward:—"If a level be driven one or two hundred yards under ground through the solid rock, there will be no danger of its not continuing entire for an indefinite length of time; but if the sides and roof only of the level be formed in the rock, and the bottom be cut through into a bed or substratum of clay, however strong and stubborn it may be, being pressed by the weight of the superincumbent rocks, it will imperceptibly swell and rise up in the level; and, unless it be continually pared down, or prevented by some means, the level will, in no great length of time, be entirely choked up." The masonry of the piers was carried up with horizontal and vertical bonds to the springing, where they radiated in wedge-like courses that received the line of direction, or force of the arch. (See the prefixed engraving.) The piers are 60 feet in height, from the bed of the river to the top of the parapet, and 24 feet in width.

[*From the London Mechanics' Magazine.*]

MODE OF BUILDING A DOME WITHOUT CENTERING.—I was glad to see the communication of "A Country Gentleman" in your Magazine, because such an inquiring spirit as your correspondent manifests, gives promise of a kindly feeling that may quicken and spread among the class to which he belongs, when it shall be found that those of that class who desire practical knowledge emerge from the folds of their seclusion, and seek it where it is most likely to be met with—among practical men. I was also gratified to prove the truth of my constant belief, that many gentlemen neglect inquiry at home, not from a lack of patriotic spirit, but from a notion that the required information can only be obtained abroad—being often struck by some apparent novelty, without being aware that it had grown stale in their native land.

I believe the method of building a dome without centering has been known to English mechanics for a time longer gone by than can be traced with certainty. In fact, the process is so simple, that, although it might not have struck a theorist so immediately, a practical man could hardly have proceeded far in his work without being led into it. We will suppose such a practical man commencing a dome without any knowledge of the proper method to be pursued. He lays the first course of material at the spring of his intended dome, inclining a little inwards; he follows with a few more courses until he finds their inclination become too great to allow them support; he then, very naturally, endeavors to make his blocks *support themselves;* he tries various methods of accomplishing this, and cannot be long in hitting upon the best, from its very simplicity. Mere accident, perhaps, gives him the first idea of it; one block being left below the regular course, he will find another block upon this supported by the ends of the two adjoining and more elevated ones, in the manner here represented:

This will lead him to the more uniform and "solid" method of raising alternate courses, each block half its thickness higher than its neighbor: he thus will find he can build his dome up to its summit without centering.

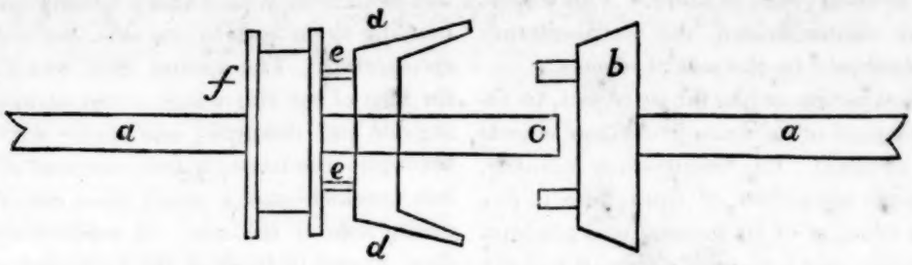
For the purpose of showing this practically, I have made a model of a dome about 3½ inches diameter, formed of upwards of 150 pieces, which your correspondent may inspect if he will name a place to which it may be sent.

Yours, &c. SAMUEL DOWNING.

November 5, 1832.

[*From the London Mechanics' Magazine.*]

FRICTION CLUTCH-BOX, FOR ADJUSTING THE CONNECTION BETWEEN A CONSTANT GOING WHEEL AND INTERMITTING MACHINERY.—Some years since machinery was put up in a building adjoining a mill which often wanted going and stopping. Being driven by wheels with teeth, it was necessary, to prevent a fracture, that the water-wheel should be stopped. As this was found very inconvenient, after some thought, the following method was tried, and has answered ever since. Apprehending it might be useful in many cases, I take the liberty to request the insertion of this description of it in your Magazine. The machinery



alluded to was driven by an iron square bar, and the improvement consisted in the introduction of a connector, which, in the absence of a better name, I shall call a friction clutch-box, which is different from any thing I have hitherto seen. The one-half of this box, with two studs, is fixed, as usual, at one end of the shaft to be connected, and the outer circumference is levelled about $\frac{1}{8}$ of an inch in an inch long, forming part of a cone; and the other half of the box has a broad hoop fixed thereon, and standing forward like a cup, which, when pushed forward on the cone, gradually produces friction sufficient to set the machine a-going; and then there are two bolts previously drawn back which are made to slide through this latter half box, and lay hold of the studs. The improvement will, however, be made clearer by reference to the prefixed sketch.

a a represents the bar cut in two at *c*; *b* the fixed half of the box, with the two studs fixed, and fixed on shaft; *d d* the other half of the box with hoop; *e e* two bolts fixed into *f*, and made to slide through *d*, far enough to grasp the studs in *b*.

As here represented, the bolts are withdrawn and out of work. Care must be taken that *f* with the bolts are not forced forward, until the motion is gained by pushing *d* on the cone.

N. B.—*d d* may have a groove as well as *f*, to put the lever into force backward and forward; and the end of the two bolts should be riveted enough to prevent their being withdrawn out of *d*; but tbey should be drawn back flush when disengaged. W. S. S.

An account of some experiments made at Woolwich with Jones' Patent Iron Wheels. By Wm. Baddeley. [From the London Mechanics' Magazine.]

Sir,—In your 245th number, you have given an excellent description of Messrs. Theodore Jones & Co.'s patent wrought iron suspension wheels, and in No. 347, an account of a very successful experiment made with them at the opening of the stone tram-way in the Commercial road. To these, I have now the pleasure of adding a description of some highly interesting and satisfactory experiments, that were made at the Royal Arsenal, Woolwich, in October last, under the superintendence of Major-General Hardwicke, and Lieutenant-Colonel Forrest, and in the presence of several officers of the Royal Artillery, to ascertain the fitness of the patent wheels for the general purposes of the Honorable East India Company's Ordnance Department in India.

In the first experiment, a pair of the patent wheels, five feet high, with six inch tire, were fitted to the carriage of an iron twenty-four pounder, weighing 50 cwt. 1 qr. 25 lbs.

Another pair of these wheels, five feet high, with three-inch tire, were fitted to the carriage of a brass twelve pounder, weighing 18 cwt. 5 lbs.

To each gun was attached its timber, furnished with the usual wooden wheels; the twenty-four pounder was drawn by six—the twelve pounder by four horses. The experiments commenced with briskly trotting, and sometimes sharply galloping the guns, over a very rough pavement, for upwards of an hour. The roughness and unevenness of the paving was so great, that the carriages bounded from stone to stone with great violence, sometimes springing a distance of several feet.

So great indeed was the violence with which the guns were galloped, that the rope lashings used to keep the guns in their places on the carriages were broken, and the twelve pounder carriage was jerked completely off its limber.

On a close examination of the patent iron wheels, after they had been subjected to this unusually severe trial, not the slightest appearance of injury was any where perceptible. The wooden wheels of the limbers, however, did not stand the shaking so well, although they had nothing but the weight of the empty limber boxes to carry; all the spokes were more or less started from their sockets; on measuring some of the openings, they were found to be three-sixteenths of an inch wide. Nor is this much to be wondered at, when it is considered that they were new wheels, which had

been lying several years in store. This experiment fully demonstrated the extraordinary strength possessed by the patent wheels.

The 2nd experiment had for its object, to ascertain the nature of the draught of these wheels upon *soft* ground. The twenty-four pounder, with a weight altogether of from four to five tons, and a draught of six horses, was attempted to be drawn over a piece of very soft marshy ground. The wheels sunk in too deep, however, for that number to draw them out; the poor horses were struggling and sinking up to their knees in the marsh, when two more were added; but, during the time that was occupied in attaching them, the wheels had sunk in to such a depth that it required the exertions of several men in addition, to start the carriage. This experiment was neither so satisfactory nor so fair as could have been wished; *ten* horses should have been attached in the first instance, and then, the gun would have been drawn through the swamp without stopping.

By the regulations of his Majesty's service, eight horses are allowed for a twelve pounder, weighing about 18 cwt.; it ought not, therefore, to be expected that six horses should draw a load of 50 cwt. exclusive of the carriage, &c. through such a swamp as that in which this experiment was made.

In the next experiment, two twelve-pounders were drawn through the same marsh: one being mounted on Jones' patent wheels, the other on wooden wheels. Four horses (half the regular number) were attached to each; both passed through the marsh without stopping, but with great difficulty, the iron wheels appearing to have a slight advantage. The iron wheels, with six-inch tire cut into the soft ground, which adhered to the inside of the rim; but the wheels with three-inch tire did not collect the earth in the same manner.

The twelve and twenty-four pounders were then ranged in battery in front of the butt, and three rounds, with full service charges (one shot each,) were fired from both; no visible effect whatever was produced upon the wheels by the firing.

The final experiment consisted in ascertaining the comparative effects of a cannon ball upon the iron, and upon wooden wheels. For this purpose, one of the iron wheels was placed in front of the butt, and a twelve-pounder in the battery, at the distance of about two-and-thirty yards, brought to bear upon it. The first shot struck the wheel in an oblique direction, cut two of the spokes asunder, as clean as if it had been done with a sharp cutting instrument, bending them both to one side, *but without any splintering*. The second shot was directed to the face of the rim which it cut asunder, bending one end inwards; one spoke was also cut through—the nave grazed—one end of the nave box cracked—and a small piece cut off the opposite side of the rim. A wooden wheel was then placed in front of the butt, and submitted to the same rough treatment.

The first shot from the twelve pounder shattered two of the spokes, the splinters flying about very much. Shot the second struck the tire a little below the centre of the nave, which it shivered to pieces, the splinters flying in every direction, some of the fragments being thrown to a considerable distance. This wheel was completely "done for," and was incapable of being repaired; nor could it be rendered available for conveying the gun off the ground.

Not so the iron wheel; for, on the command being given to march home, though sadly mutilated, the wheel conveyed the gun a considerable distance.

The battery experiments, as detailed above, were most ably assisted by the exertions of Captain Rawnsley, of the Royal Artillery, who superintended laying the guns, which was done with an accuracy and effect hardly to be exceeded; and which, on the present occasion, contributed materially to the success and satisfactory nature of the experiments.

In a report made by Major-General Hardwicke and Lieutenant-Colonel Forrest, to the Court of Directors of the Honorable East India Company, they express their opinions of the merits of the patent wheels in the following words:

"From the foregoing experiments, it is but justice to the patentees of the iron wheels to record the advantages under which they appear.

"First, They are stronger, and not so easily disabled in action, and when struck with a cannon ball *do not splinter*.

Secondly, When they sustain an injury to the extent of two or three spokes broken, the wheel might be continued in use till an opportunity occurred of repairing it, while a wooden wheel under similar circumstances would, for the time, be unserviceable.

"Thirdly, The iron wheels are not subject to those changes which influence of climate and changes of seasons work on wood wheels. We have seen in the course of these experiments, that new wheels that have lain a few

years in store, would require to be set up before sent on service. No length of time can render this necessary with the wrought-iron wheels."

Any comment upon the foregoing is quite unnecessary.

Smoky Chimneys. By R. [From the London Mechanics' Magazine.]

I have not for some time read any thing with greater pleasure than the judicious remarks of C. D. S.

An association of architects for the purpose which he suggests, commencing on scientific principles, would, doubtless, have but little difficulty in devising objects more sightly than, and equally efficient with, those at present in use for the cure of smoky chimneys.

All those who have any pretensions to order and taste, must, in common with your correspondent, have felt disgusted with the general means employed to eradicate the evil in question; and every one who loves to breathe the pure air, and knows the value of it, should do his utmost to forward the suggestions alluded to, as the result would not only be highly gratifying to those who can appreciate the beauty of judicious architectural forms, but also beneficial to those who have no just conceptions of the value of untainted air.

In the present enlightened and inquiring age, we must not, however, rest satisfied with merely ascertaining in what way the annoyance can be got rid of; but we must also know the fundamental cause of the existing evil, as well as sufficient reasons why a chimney-pot is calculated to effect a cure. This is the true way to proceed to arrive at a favorable conclusion; and unless a society start upon those principles their labor will prove unsatisfactory.

It may be said, that "the means and experiments employed to effect a cure, will at the same time disclose the cause;" but this may not be the case. Indeed, to know the cause of the good or evil we daily experience, is a point, I am sorry to say, that we trouble ourselves very little about. We know from experience that certain agents produce certain effects; so we generally take things for granted, without ever inquiring into the nature of the operation. The bricklayer puts up a chimney-pot to cure a smoky flue, upon the same principle that the apothecary's patient swallows physic, in hopes of a certain result; namely, because they know that the same means had in former cases produced the effects they now wished for. But we must know the "why" and the "wherefore," before we can be said to know much about the matter.

In recommending the foregoing as the fundamental principles to be observed by a society for the laudable purpose that your correspondent suggests, I shall here subjoin my own humble opinions on the matter of smoky chimneys; which I do with due deference to those who have had more experience, and paid more attention to the subject, than myself.

To define the particular cause of a smoky chimney, unless some individual cause were pointed out, is utterly impossible. We all know that the best constructed flues are liable to smoke occasionally in bad weather, when the density of the atmosphere is less than in fine weather; the reason is, that when the specific gravity of the atmosphere is reduced and approaches nearer to that of smoke, the latter cannot ascend so freely: because the weightier the atmosphere the more rapid is the ascent of the smoke, on the same principle that a current of water passes an impediment with greater velocity than where it has no obstruction. This cause, however, seldom occurs, which is as well, as we can never overcome it: the chief causes are the following—

Flues that are not properly *drawn in* immediately above the fire-place, are liable to smoke; because a wide opening may contain more air than the fire can properly rarify; which, therefore, passes on to join the air of the room, carrying the smoke with it; while, on the other hand, flues that are narrow at the throat not only obviate this, but a smaller cavity opening into a wider one creates, of course, a greater current. Chimneys which are built in sheltered situations are liable to smoke for want of a free circulation of air round the chimney-tops: this, however, I shall presently explain more fully. Flues that are not properly pargeted or plastered inside, are also liable to smoke; because the air penetrates through the porous nature of the bricks, as well as between them when the mortar is decomposed. Square or parallelogram flues are very bad forms; because smoke always ascends in a circular column, and therefore the angles of these forms serve as receptacles for cold air. When the divisions between the flues are very thin, the consequence is also bad; because, occasionally, the chimney of the next flue may have no fire on, and, therefore, the cold air penetrates through the thin divisions. The preceding deficiencies, with other topical circumstances,

may be considered the chief cause of smoky chimneys.

A chimney that smokes from any of the foregoing defects, or from any other cause whatever, and is cured by a chimney pot, would, in the event of the chimney pot being removed, and the stack of chimneys carried up in a body, even as high as the loftiest "tall-boy," again return to smoking; because, it is not the additional height that effects the cure, but the freer circulation of air round the openings of the flues. When a number of flues are built in one chimney stack, as is the case with street houses at present, it is obvious that a current of wind (which generally passes in a horizontal direction), when interrupted by a broad mass of building, rises perpendicularly to the top of the impediment, and then resumes its horizontal direction; so that, in passing over the flues, it not only prevents the free exsurgence of the smoke, but frequently finds its way down into the flues. The chimney-pots, on the other hand, divide the current of the wind, which has a free passage between them. Since, therefore, chimney-pots cannot be avoided in certain situations, and with certain connected circumstances, it behoves architects to devise proper architectural forms, suitable for the buildings to which they may be applied, to supersede the disagreeably-colored and unshapely forms at present in use.

I intended to send you along with this outlines of forms for chimneys, characteristic of the different styles of architecture; but not knowing how far they might be agreeable to the plan of your work I have deferred it for the present.

In conclusion.—Well constructed *circular* flues, with *sweet* windings or turns, well drawn in at the throat, and properly pargeted or plastered, brought together as much as possible for the sake of heat, and carried up in one body to the roof, placed in the internal walls, the chimneys carried up to a moderate height above the roof, with openings between the shafts, the coping bevelled outwards to serve the double purpose of throwing off the rain, and conducting upward the transit of the smoke,—will scarcely fail to vent well in any situation. Bayswater, Aug. 20, 1832.

[*From the American Railroad Journal, &c.*]

Railroads for Private Use.—The force of traction necessary to propel a ton's weight on a level road is eight pounds. To propel the weight of an ordinary human body, or 140 lbs. would require at this rate just half a pound. As easily, then, as such a person could walk up several flight of stairs to the height of thirty-two feet, he could move his own weight upon a level railroad one mile and three-quarters; and if we include a light carriage of 140 pounds, he could move himself and his carriage three-fourths of a mile as easily as he could walk up stairs 32 feet. The ease with which persons can walk on level ground, or a floor, is an argument for level roads, which many must sensibly feel; but, whatever be the ease with which persons can walk on level ground, they cannot move forward with great rapidity, nor without some fatigue; but a wheel is not put out of breath, and a friction on the axle, of a few inches, carries it forward several feet. For innumerable occasions this facility of moving would be exceedingly convenient in a vast variety of lines of communication, where large railroads for steam or horse power could not be supported. There are innumerable occasions on which families in the country wish to convey articles a few miles to a store, which they cannot carry in their hands, and which are not a load for a horse. In these cases it would be very easy for a man, or even a woman, to take a beautiful, fancy rail-car, of 140 pounds weight, and take a load of 200 pounds weight, and go on a dry rail, when a common road is deep with mud, some four or five miles to a store. In this case no more effort would be necessary than would be required to raise up over a pulley a weight of one pound and two-thirds. It would require no more force to move through the whole four miles, the carriage of 140 pounds, the load of 200 pounds, and the person of 140 pounds—in all 480—than for the person of 140 pounds to walk ten times up a flight of stairs of 26 feet in height. Publicola.

Improved Method of Aquatinta Engraving. By Mechanicus. To the Editor of the Mechanics' Magazine and Register of Inventions and Improvements.

Sir,—If the following short account of the method of effecting aquatinta engraving is thought worthy of a place in your valuable publication, it is at your service.

After the intended figure is outlined, by etching or otherwise, the plate is covered all over with a ground of rosin, Burgundy pitch, or mastic, dissolved in rectified spirits of wine; this is done by holding the plate in an inclined position, and pouring the above composition over it. The spirit of wine almost immediately evaporates, and leaves the resinous substance

in a granulated state, equally dissolved over every part. The granulations thus produced, if examined through a magnifying-glass, will be found extremely regular and beautiful. When the particles are extremely minute, and near to each other, the impression from the plate appears to the naked eye exactly like a wash of Indian ink; but when they are larger, the granulations appear more distinct. This powder or granulation, is called the aquatinta grain. The plate is next heated to make the powder adhere; and in those parts where a very strong shade is wanted, it is scraped away; but where strong lights are wanted, a varnish is applied. The aqua fortis, properly diluted with water, is then put on with a piece of wax, as in common etching or engraving; and by repeated applications of this process, scraping where darker shades are required, and covering the light parts with varnish, the final effect is produced.

Engraving by aquatinta was invented by Le Prince, a French artist, by whom the process was long kept secret. It is even said that for some time he sold his prints, (which are still reckoned excellent specimens,) for drawings.

Sub-Marine Adventurers. By J. Elliott.

[From the London Mechanics' Magazine.]

Sir,—From a paragraph, in the newspapers, it appears that Mr. Dean, the diver, is now at Spithead engaged in recovering property from a vessel wrecked there some years ago. Mr. Dean is the same person who descended to the bottom of the River Thames on the 5th of December last, from a barge moored near the centre arch of Southwark Bridge. At high water the diver made his appearance habited in a sort of canvass dress, having a coil of tubing round his body, and a sort of helmet on his head; about his middle were affixed weights to enable him to sink easily. A rope being made fast round his body, he descended a ladder fixed at the head of the barge, and went to the bottom of the river, and remained under water at least 4½ minutes; he then came up the ladder and delivered something he had taken from the bed of the river to the people in the barge. He next again descended, and remained under 9½ minutes; he then came on board the barge and divested himself of the whole of the apparatus in a few minutes.

I believe Mr. Dean's contrivance is something similar to an apparatus patented a few years ago by a correspondent of the Mechanics' Magazine, Mr. Steele, of Magdalen College, Cambridge.

In the month of January, 1828, I was on board the Bell Lighter moored over the Thames Tunnel, when Mr. Gravatt, the engineer, descended. He was under water nearly an hour, and the weather was exceedingly cold, yet I observed that when he came out of the bell he seemed to be in a profuse perspiration; a circumstance which confirms, in some measure, the experimental observations of Mr. Milne, as detailed in Number 471.

At the time of the first irruption of water into the Tunnel, Mr. Faraday descended in the bell with Mr. Brunel, jun.; and in a Lecture at the Royal Institution, Mr. F. stated a remarkable fact, that Mr. Brunel, when he dived under water from the bell into the Tunnel, was able to remain full *two minutes* under water without experiencing any great inconvenience. He accounted for the fact in this way: when the bell was lowered to the greatest depth (about 15 feet) the air inside was necessarily much compressed; the persons in it, therefore, though they inhaled the same *bulk* of air which they would under other circumstances, yet as two atmospheres were compressed into one, inhaled twice the *quantity*, and of course a much larger supply of oxygen was furnished to the lungs. Yours, &c. J. Elliott.

We subjoin an account extracted from the Norwich Mercury, of the exploits of another diving adventurer of the name of Bell, which are in most respects similar to those of Dean, but distinguished by one or two novel circumstances.—[Ed. M. M.]

Mr. Bell's operations.—"There is a small cutter now lying in our (Yarmouth) roadstead, belonging to a man named Bell. Her crew consists of six men, several of whom are singularly expert in diving. She sails about from place to place, to offer assistance to recover lost treasure, &c. She has arrived for the purpose (by permission of the Admiralty) of endeavoring to obtain a portion of the treasure lost in the Guernsey Lily transport, which got on the Cross Sand, floated off, and afterwards foundered in the centre of Yarmouth roads, in 43 feet water, coming with stores, &c. from Holland, after the Duke of York's expedition in 1799. The transport was laden with horses, ammunition (in which were 25 brass field-pieces), a stock of wine, &c. The method these divers use is curious:—The cutter is first placed immediately over the wreck, the diver then, habited in an India-rubber air-tight dress, having a tube attached at the back of the neck to receive the air (which is constantly kept pump-

ing in) descends from a rope ladder, and gives signals for certain things to be sent down by a small line, which is attended to by those on the deck of the cutter; by this line baskets and other utensils are sent down for the use of the diver, and sent up again with wine, &c. taken from the wreck. The diver's head-dress is curious: it is composed of copper, and is a complete covering, much after the manner of the ancient helmet, only that it is made larger than the head, and has in its upper part three glass windows; it weighs 50 lbs. He has two other dresses on besides that above-mentioned. He carries down with him 120 lbs. of lead in two bags. With all this weight he declares that when in the water he appears perfectly free from weight or incumbrance of any sort. There has been already brought up a large quantity of wine (the bottles curiously tattooed with large and small oysters, which have been tasted, and are excellent), some copper, iron handles of chests, pieces of gun carriages, &c. They hope soon to be in possession of the brass guns, valuable plate, and the dollars which it was known the transport had on board for the purpose of paying the troops employed in the above-mentioned expedition. The Admiralty, we understand, has handsomely given permission to Captain Bell to make what use he pleases of the articles found, only conditioning that the brass guns, if recovered, shall be given up, for which they will return value. Great numbers of persons from different parts of the country have been off to view this novel and singular undertaking. The diver, when under water, finds his strength so increased, that he can bend the ends together of the large iron crow-bar (3½ feet long and 9½ inches in size) which he takes down with him to part the wreck. These divers go down alternately about twice a-day, but are compelled to take advantage of the tides when it is slack water."

Braithwaite's Steam Fire-Engine. [From the London Mechanics' Magazine.]

We witnessed a very gratifying display of the powers of this engine at the great fire at Messrs. Barclay and Company's brewery, on Tuesday last. The fire broke out about five o'clock in the afternoon, but, unfortunately, more than three hours were suffered to elapse before the steam fire-engine was sent for, and as it had then to come from a distance of four miles, it was near ten o'clock before it was brought into play. When we reached the scene of the conflagration, which was shortly after eleven o'clock, we found the engine in full operation, under the direction of Messrs. Sidney and Septimus Braithwaite, and Mr. Milner, jun. From that time till five o'clock in the morning we saw it in constant work; ejecting between thirty and forty tons of water an hour, and to heights, as occasion required, not much short of 100 feet. Mr. John Braithwaite joined the forces of the "Steam King" in the course of the night, and greatly distinguished himself by the spirit and intrepidity with which he personally directed the stream of water on the most dangerous parts of the burning pile. We saw also some of the ordinary engines very well worked, the Guardian in particular; but by the time the steam fire-engine came into the field, the firemen of all the others had been greatly exhausted, by several hours' hard working during the worst period of the conflagration. One of the strongest recommendations of the steam fire-engine is, that when once set to work it *never tires*. We were informed by one of the partners in the brewery that the Norwich Company's engine had in the early part of the evening distinguished itself beyond all the other engines, by the vigor with which it attacked some of the loftiest parts of the premises. The manner in which the fire originated may furnish a useful lesson to all persons who have occasion to introduce lights into apartments where there are ignitible particles floating about. A workman was proceeding with an open lamp in his hand to grease a part of the machinery called Jacob's Ladder, when the dry malt-dust, with which the atmosphere of the place was impregnated, caught fire, and spread so rapidly and irresistibly, that within an hour the whole of the working part of the brewery was in flames. The damage is estimated at about £50,000.

On the Formation of Waves—their altitude, breadth, and time of undulation. By Juvenis. To the Editor of the American Mechanics' Magazine, and Register of Inventions and Improvements.

When the surface of water is unequally pressed on, in parts contiguous to one another, the columns most pressed on are shortened, and sink beneath the natural level of the surface, while those that are least pressed on are lengthened, and rise above that level.

As soon as the former columns have sunk to a certain depth, and the latter have risen to a certain height, their motions are reversed, and continue so till the columns that were at first most depressed have become most elevated,

and those that were most elevated have become most depressed.

The alternate elevations and depressions thus produced are called *waves*.

The water in the formation of waves has a vibratory or reciprocating motion, both in a horizontal and a vertical direction, by which it passes from the columns that are shortened to those that are lengthened, and returns again in the opposite direction, progressive motion not being necessary to undulation.

The vibrations of water in the form of waves, may be compared to the reciprocations of the same fluid in a syphon or bent tube; and it was from this that Newton deduced the velocity of waves, and the time required for an undulation.

The *time* of an undulation is the time from the wave being highest, at any point, to its being highest at that point again. The *velocity* of the wave is the rate at which the points of greatest elevation or depression seem to change their places.

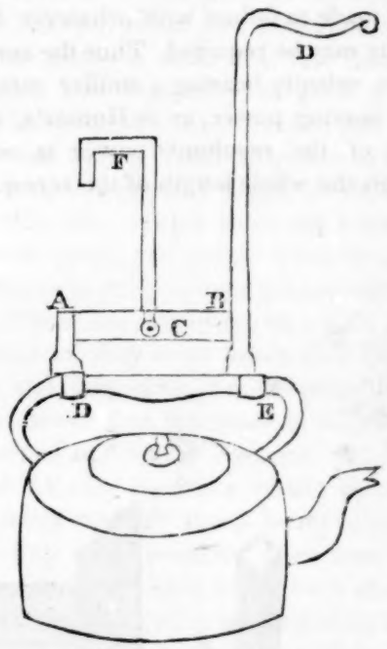
If the altitude and breadth of a wave be known, the time of an undulation and the space which the wave appears to pass over may be determined as follows:—To find the *time* of an undulation, add half the breadth of the wave to its altitude, multiply the sum by ·3927, and the square root of the product will be the time in seconds. (This number is one-eighth of the circumference of a circle whose diameter is 1.) Thus, suppose the breadth of a wave to be 14 feet, and its height 3 feet, required the time of an undulation. Here the sum of the height and half the breadth is 10, which multiplied by ·3927, becomes 3·927, the square root of which is 2, nearly, the number of seconds in which an undulation is performed.

To find the *space* which the wave passes over in one second:—Divide half the breadth of the wave by the square root of the altitude, and half the breadth, multiplied by 3·927, and the result will be the space passed over by the wave in one second.

Thus, suppose the breadth and height of a wave to be as stated in the preceding example, and it is required to find the space it will pass over in a second of time. Here the square root of 10 is 3·1, nearly, which multiplied by ·3927 is 1·22, nearly; and 7 divided by this number quotes $5\frac{3}{4}$, nearly, which is the space passed over in one second.

While the depth of the water is sufficient to allow the oscillation to proceed undisturbed, the waves have no progressive motion, and are kept, each in its place, by the action of the waves that surround it. But if by a rock rising near the surface, or by the shelving of the shore, the oscillation is prevented, or much retarded, the waves in the deep water are not balanced by those in the shallower, and therefore acquire a progressive motion in this last direction, and from *breakers*. Hence it is, that waves always break against the shore, whatever be the direction of the wind.

Breakers formed over a great extent of shore are distinguished by the name of *surf*. The surf is greatest in those parts of the earth where the wind blows always nearly in the same direction: but in the foregoing observations, no allowance is made for winds.



Improved Kettle-Holder. By G. J. [From the London Mechanics' Magazine.]

Sir,—A B is a slender bar of iron, or strong piece of hooping. A D, B E are hooks of equal size fixed at A and B; but E B is prolonged upwards to D, where it is turned off square to form a handle. F is a hook, admitting of being turned freely round its centre-pin C. The hook F is hung on across the pot-hook, and the kettle on the hooks D E; there is also a spring, which is welded on A B, and entering the mouth of the hook E, prevents the kettle from slipping. The operation then is to draw the handle D towards you, when the water will be steadily discharged without giving you any chance of scalding or burning your fingers. The contrivance is so simple and cheap, that I have no doubt any blacksmith would make it for two or three shillings.

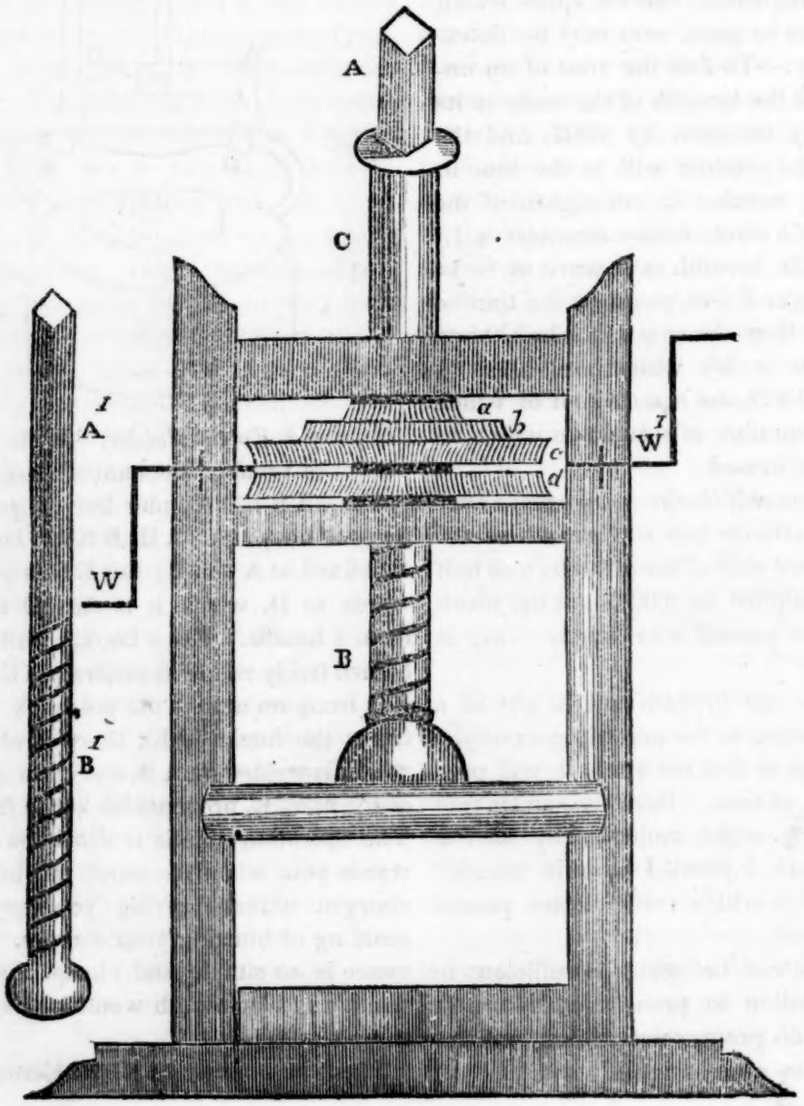
It will at once appear, Mr. Editor, that this is

an useful kitchen utensil, and as such, I feel assured that its description will not be denied a place in the pages of the Mechanics' Magazine.

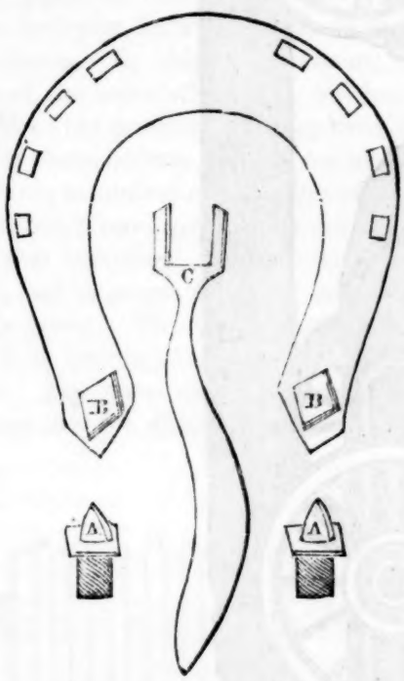
Hunter's Screw-Press, improved. By Φ. M.

[From the London Mechanics' Magazine.]

Sir,—I beg leave to submit to the consideration of your readers the following design for extending the range of an admirable invention, which must be familiar to most of them—I mean Hunter's Screw-Press. My principle is, instead of using Hunter's triple combination of nut and screw, to use only a nut and screw with a supplementary apparatus, which shall have the effect of making the screw, as it were, run away from the gripe of the nut, while the nut is made to follow with whatever degree of velocity may be required. Thus the screw rises with a velocity bearing a similar ratio to that of the moving power, as in Hunter's, while the range of the resultant power is continued through the whole length of the screw. In the accompanying figure, A′ B′ is the screw taken out of its place; a square projection of equal length with the screw is added to it. The head of this square part is seen in the figure, at A, rising out of C, in which it slides. C is a tube with a circular bore, wide enough to admit the screw freely, but closed by a square aperture, through which the square projection works. C is of one piece with *a*, *b*, and *c*, and works resting upon *d*, which is the real nut. *a*, *b*, *c*, and *d*, are furnished with teeth, and a winch is affixed by a contrivance which will allow of its engaging either *a*, *b*, *c*, or *d*, individually, or *c* and *d* together. *a* may be supposed to have 50 teeth, *b* 100, *c* 200, and *d* 200. *a*, *b*, and *c*, are intended merely to bring the screw down to its work, or to perform light tasks; and when the winch engages any one of them, *d* is clamped. When the screw is required to do its utmost, the winch is made to engage *c* and *d* together; then *c*, by means of its hold on the square projection, keeps the screw going before the



nut, while the nut is overtaking it at the rate of one tooth for each revolution. The construction given in the figure is one of several, and not the best, but the one I found least troublesome to copy. I hope some of your correspondents will favor us with an opinion of the merits of the machine as thus altered, and also with a calculation of its powers, taking for data the winch at 15 inches radius, the moving power at 30 pounds, as, also, that one revolution of the winch passes one tooth, and that one revolution of the nut *d* passes one thread of the screw, the interval between any two threads being 2 inches.



Improved Horse-Shoe. By T. P. [From the Voice of Humanity.]

Sir,—I was lately travelling in a coach, early in the morning; it was one of those mornings which are so distressing to smooth-shod horses. In the night there had been a considerable fall of sleet, with a little rain, and this fall was immediately followed by a very hard frost, so that the road was one complete sheet of ice. Coming on so suddenly, there was no time to get the horses rough-shod, and their consequent suffering was great. They were down and up, first one and then another, all the way.

In order to get up one little hill, all the passengers were asked to get out and off from the coach, and even then it was with the greatest difficulty that the coachman could force the horses up. He was obliged to "lash them into madness;" sometimes two were down together, and once all four were down at the same time, and when they had scrambled to the top, they were in a pitiable state of exhaustion, the sweat literally running from them as though warm water had been poured on their backs, although so cold a morning.

It struck me at the time that it would be easy to make horse-shoes which might be turned up, as it is termed, in a few minutes. I send to your appropriate publication a drawing of the sort of shoe which I have invented.

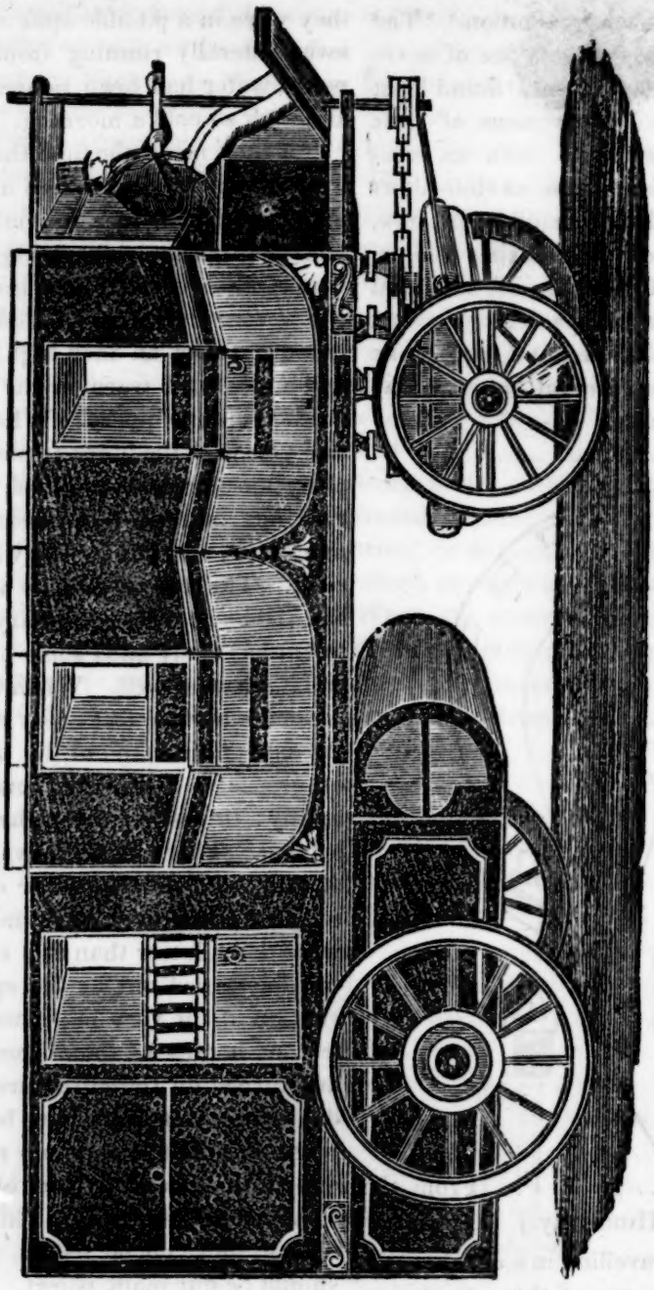
The two steel nuts marked B are made barely a quarter of an inch high, about one-eighth and a half, and worn in the winter when the roads are not slippery. When the frost comes, and you wish the horse turned up, or more properly speaking, rough-shod, you take out the two nuts marked B by means of the spanner marked C, and put in the two steel nuts marked A. The whole is done in a few minutes. Mr. Holmes, the veterinary surgeon of this town, has lately shod some horses in this way, and it answers well. When the groom or ostler picks his horses' feet every night, he should at the same time take out the nuts, put a little oil or grease to them, and screw them in again tightly: this is to prevent their getting fastened by rust. There should always be a little store of nuts, that as they wear down they may be replaced; and they must not be permitted to wear down lower than that state in which they can be turned out by the spanner. The prevention of the very injurious effects upon the feet of horses by their shoes being taken off and turned up (often required from frost in a day or two after they have been newly shod) is worth consideration, to say nothing of its being done in haste and the foot often pricked.

Above all this, rational humanity and kindness to those docile, useful, and noble animals, should be our main object. Let them ever be considered as gifts from the Almighty Creator, for our use and comfort, and let them ever be treated with gentleness. Indeed, I believe they are seldom ill-treated but by men of vulgar minds, unthinking or uneducated; or, if educated, their education not based on Christian principles, and, without that base, I hold all education defective, if not mischievous.

Birmingham, Feb. 9, 1832.

[*From the London Mechanics' Magazine.*]

Walter Hancock's Steam Carriage.—The engraving on the following page represents a new steam carriage, which Mr. Walter Hancock has just built to run on the road between London and Greenwich. For the following par-

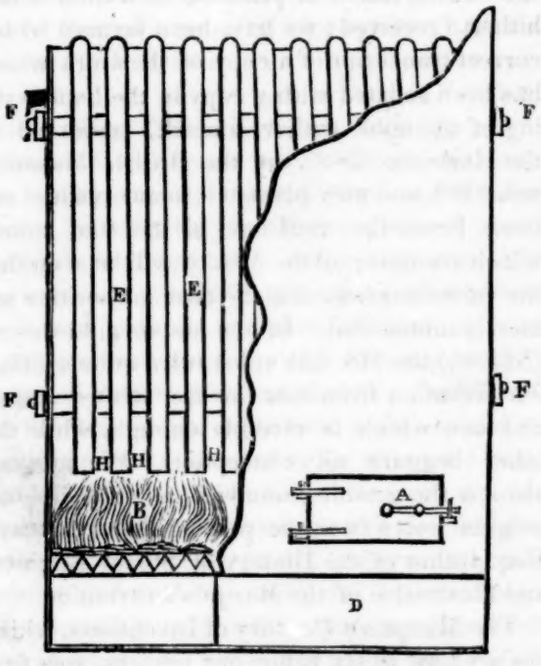


ticulars of its construction, we are indebted to Mr. Gordon's valuable H storical and Practical Treatise, reviewed in our last number.

There are two engines, which are placed before the boiler and turned with the stuffing box down, so that the cylinders are uppermost, and the piston and connecting rods below. The crank shaft with two cranks is supported by a flexible frame, which provides for any concussion on rough roads. A chain passes over a sheave on the crank shaft, and over a larger sheave on the hind axletree. The wheels turn loose on the axle, and one or other, or both, are fixed by a clutch when required. This clutch is on the outside of the wheel, and can be screwed out or in, as the case demands, with great facility. The turning of the carriage round to the offside is prepared for, by throwing out the offside clutch, and keeping in the near one; and the turn round to the near side is prepared for by throwing out the near clutch, and throwing in the offside clutch. A little play is left between the catches in each clutch, so that a winding road may not oblige either wheel to be disengaged; and it is only in a short turn, or a turn round, that the clutch must be shifted, and this can be done in a very small space of time.

The engraving annexed represents an elevation of the boiler, with part of the casing removed for the purpose of exhibiting the interior

there are two. B the fire-place; D the stoke-hole; E E the chambers, constructed of the best wrought iron; F F shows the manner in which all the chambers are bolted together, so as to form a large boiler of many compartments. There are fillets of iron, which keep the individual compartments at a proper distance from each other; and the spaces which these fillets leave are the flues of the boiler, through which the flames ascend, as shown at H H H. All these compartments are connected at the bottom for the purpose of keeping the water in each at the proper level; and at the top the steam is conveyed from each by as many pipes as there are chambers into the steam feed-pipe, by which steam is conveyed to the engines. By this arrangement, the only parts of the boiler which can be dreaded are the sides; but good ties will keep them together. And as to the bottom end, and top of the boiler, which are composed of the edges of these compartments, if one part is burnt out or hurt, it is only that individual compartment which can burst, and its power of doing mischief is not worth notice. The fire is urged by a blower which is driven by a connexion with the engines. The waste steam is blown from the engines into the chimney, and so destroyed.



The passengers are carried on the same machine, Mr. Hancock preferring that disposal of the weight to the dragging of it in a carriage behind. The wheels of the carriage are a beautiful exhibition of strength and lightness combined. The spokes are all wedge-shaped, and where they are fastened into the nave abut against each other. Their escape laterally is prevented by a large iron disc at each end of the nave; and these being bolted through, confine the spokes securely in their place.

On the Strength of Men and Animals. Selected for the American Mechanics' Magazine.

The form and construction of the human body renders it peculiarly applicable as the first mover of machinery, and what it wants in strength is compensated in a great degree by the skill and judgment with which it can be applied. When we consider the great number of cases in which it is preferable to employ the action of men rather than that of inanimate agents, and the still greater number in which it is out of our power to employ any other, it becomes a matter of the highest importance, both to workmen and to those who employ them, to ascertain the way in which the greatest quantity of work can be obtained from their exertions, with the least quantity of bodily fatigue, or with such a quantity of fatigue as they can easily bear from day to day, without injuring their corporeal functions.

Daniel Bernoulli indeed maintained that the degree of fatigue is always proportional to the quantity of action by which it is produced; that, whether he walks or carries a load, or draws, or pushes, or works at a winch, or raises a weight, he will always produce with the same degree of fatigue the same quantity of action, and therefore the same effect; and that the daily labor of a man, whatever be the work to which he is set, may be reckoned at 1,728,000 pounds raised through the height of one foot, or 60 pounds raised through the height of one foot in a second, when his day's labor amounts to eight hours. These opinions were adopted by almost all subsequent authors, on the authority of vague and inconclusive experiments, till the subject received a full investigation from the celebrated Coulomb, Amontons, and others.

According to M. Amontons, a man weighing 133 French pounds ascended 62 French feet by steps in a minute, but was completely exhausted.

A sawyer, according to the same author, made 200 strokes of 18 French inches each, with a force of 25 pounds, in 145 seconds.

An ordinary man, according to Desaguliers, can turn a winch with the force of 30 pounds for 10 hours, with a velocity of 2½ feet per second.

Two men, according to Desaguliers, working

at a windlass with handles at right angles to each other, can raise 70 pounds more easily than one man can raise 30, an additional effect of five pounds being produced on the work of each man, in consequence of the uniform action arising from the handles being at right angles to each other.

A man may, according to the same author, exert a force of 80 pounds with a fly, when the motion is pretty quick.

A man may, also, with a good pump, raise a hogshead of water 10 feet high in a minute, and continue the work for a whole day.

According to Dr. Robinson, a feeble old man raised 7 cubic feet of water, $= 437\frac{1}{2}$ pounds avoirdupoise, $11\frac{1}{2}$ feet high in a minute, for 8 or 10 hours a day, by walking backwards and forwards on a lever.

A young man, weighing 135 pounds, and carrying 30 pounds, raised $9\frac{1}{4}$ cubic feet of wawater, $= 578\frac{1}{10}$ avoirdupoise, $11\frac{1}{2}$ feet high for 10 hours a day, without being fatigued.

The strength of men, and of all animals, is most powerful when directed against a resistance that is at rest: when the resistance is overcome, and when the animal is in motion, its force is diminished; lastly, with a certain velocity, the animal can do no work, and can only keep up the motion of its own body.

The effect of animal force, or the quantity of work done in a given time by any working animal, is greatest when the animal moves with one-third of the speed with which it is able only to move itself, and is loaded with four-ninths of the greatest load it is able to put in motion.

According to this estimate, a man who can move 120 pounds, and walk at the rate of 4 miles an hour, when working to the greatest advantage, should carry a load of 54 pounds, and walk at the rate of two feet in a second, or a mile and one-third in an hour.

In raising a weight, a man will produce the greatest effect when his weight is to that of his load as 4 to 3 nearly.

When a horse's work is estimated by the load he draws in a cart or waggon, a great reduction must be made, in order to compare the force he exerts with that which is necessary for raising a weight, by drawing it over a pulley. Though accurate experiments on the friction of wheel carriages are wanting, we probably shall not err much in supposing the friction, on a road, and with a carriage of the ordinary construction, to amount to a twelfth part of the load. If, then, a horse draws a ton in a cart, which a strong horse will continue to do for several hours together, we must suppose his action the same as if he raised up the twelfth part of a ton, (2240 pounds,) or 186 pounds perpendicularly against the force of gravity. To raise a weight of 186 pounds, therefore, at the rate of two miles, or two miles and a half an hour, (that is, 2·9, or 3·6 feet per second,) may be taken as the average work of a strong draught horse in good condition.

On this subject, however, many more experiments are wanting: to determine, for instance, the friction of wheel carriages; the difference of the exertion required to walk on a horizontal plane, and on one of a given declivity; the quantity of work done in a given time by the same animal, carrying different loads. The difference between the effective exertion of a man's strength when he moves along with his load, and when he stands, as in turning a wheel; or sits, as in rowing a boat, &c.

Marquis of Worcester's Century of Inventions.—It has been suggested to us by an intelligent friend, that the republication, in our pages, of the Marquis of Worcester's celebrated Century of Inventions would render a valuable service to science, by making it more generally known to the mass of the community, and obtaining for it, in particular, more of the consideration of practical men than it has hitherto received; we have been favored with a correct transcript of a copy of the work which has been collated with a copy in the hand writing of the noble author himself, preserved in the Harleian MSS., at the British Museum, vol. 2428, and now present it to our readers entire. From the readings in the foot notes, which are those of the MS., it will be seen that the variations between the two authorities are mostly immaterial. In one instance, however, (No. 88,) the MS. has substituted quite a different invention from that in the printed copy; and one which is credible enough, while the other beggars all conception. We purpose also, in the ensuing number, to publish some original notes from the pen of Robert Stuart, Esq. author of the History of Steam Engines, and illustrative of the Marquis's invention.

The Marquis's Century of Inventions, which we are now to lay before our readers, was first printed in 12mo., in 1683. Walpole is pleased to designate it as an "amazing piece of folly;" but later and better informed writers have been led to think differently of it. Granger remarks—"That a practical mathematician, who has quickness to seize a hint, and sagacity to

apply it, might avail himself greatly of these scantlings, though little more than a bare catalogue." And the same writer was informed by the late reverend and ingenious mechanic, Mr. Gainsborough, of Henley, brother to the celebrated painter, that the Marquis's work was far from being such a collection of whims and chimeras as it has been supposed to be, and that, on the contrary, "he highly esteemed the author as one of the greatest mechanical geniuses that ever appeared in the world." It is quite certain, too, that since his time several of his "inventions" or suggestions have been reduced to practice; and hence, the whole have become entitled to be treated with more respect. Professor Robison goes so far even as to affirm that the steam engine, the greatest discovery of modern times, "was, beyond all doubt, invented by the Marquis;" and though later researches have shown that this is somewhat unmerited praise, it is evident that he entertained views of the applicability of steam as a moving power, such as no other individual of the age in which he lived had the sagacity to embrace.

The "book" which he promises, at the conclusion of the Century, to leave to posterity, showing "the means to put in execution and visible trial all and every of these inventions, with the shape and form of all things belonging to them,—printed by brass plates," he did not live to execute.

To the King's Most Excellent Majesty:

Sir,—*Scire meum nihil est, nisi me scire hoc sciat alter,*" saith the poet, and I must justly, in order to your Majesty, whose satisfaction is my happiness, and whom to serve is my only aim, placing therein my *summum bonum* in this world: be therefore pleased to cast your gracious eye over this summary collection, and then to pick and choose. I confess I made it but for the superficial satisfaction of a friend's curiosity, according as it is set down; and if it might now serve to give aim to your Majesty how to make use of my poor endeavors, it would crown my thoughts, who am neither covetous nor ambitious but of deserving your Majesty's favor, upon my own cost and charges; yet according to the old English proverb, "It is a poor dog not worth whistling after." Let but your Majesty approve, and I will effectually perform to the height of my understanding: vouchsafe but to command, and with my life and fortune I shall cheerfully obey, and, *maugre* envy, ignorance and malice, ever appear your Majesty's passionately devoted, or, otherwise, disinterested subject and servant, Worcester.

To the Right Honorable the Lords Spiritual and Temporal, and to the Knights, Citizens, and Burgesses of the Honourable House of Commons, now assembled in Parliament.

My Lords and Gentlemen,—Be not startled if I address to all, and every of you, this century of summary heads of wonderful things, even after the dedication of them to his most excellent Majesty, since it is with his most gracious and particular consent, as well as indeed no way derogating from my duty to his sacred self, but rather in further order unto it, since your lordships, who are his great council, and you, gentlemen, his whole kingdom's representatives (most worthily welcome unto him,) may fitly receive into your wise and serious considerations what doth or may publicly concern both his Majesty and his tenderly beloved people.

Pardon me if I say (my Lords and Gentlemen) that it is jointly your parts to digest, to his hand, these ensuing particulars, fitting them to his palate, and ordering how to reduce them into practice in a way useful and beneficial both to his majesty and his kingdom.

Neither do I esteem it less proper for me to present them to you, in order to his Majesty's service than it is to give into the hands of a faithful and provident steward whatsoever dainties and provisions are intended for the master's diet; the knowing and faithful steward being best able to make use thereof to his master's contentment and greatest profit, keeping for the morrow whatever should be overplus or needless for the present day, or at least, to save something else in lieu thereof. In a word (my Lords and Gentlemen), I humbly conceive this simile not improper, since you are his Majesty's provident stewards, into whose hands I commit myself with all properties fit to obey you, that is to say, with a heart harboring no ambition, but an endless aim to serve my King and country; and if my endeavors prove effectual (as I am confident they will), his Majesty shall not only become rich, but his people likewise as treasures unto him; and his peerless Majesty, our King, shall become both beloved at home and feared abroad, deeming the riches of a king to consist in the plenty enjoyed by his people.

And the way to render him to be feared

abroad is, to content his people at home, who then, with heart and hand, are ready to assist him; and whatsoever God blesseth me with to contribute towards the increase of his revenues in any considerable way, I desire it may be employed to the use of his people; that is, for the taking off such taxes or burthens from them as they chiefly groan under, and by a temporary necessity only imposed upon them, which being thus supplied will certainly best content the King and satisfy his people, which I dare say is the continual end of all your indefatigable pains, and the perfect demonstration of our zeal to his majesty, and an evidence that the kingdom's trust is justly and deservedly reposed in you. And if ever Parliament acquitted themselves thereof, it is this of yours, composed of most deserving and qualified persons—qualified, I say, with affection to your Prince, and with a tenderness to his people; with a bountiful heart towards him, yet a frugality in their behalf.

Go on, therefore, cheerfully (my Lords and Gentlemen), and not only our gracious King, but the King of Kings, will reward you; the prayers of the people will attend you; and his Majesty will, with thankful arms, embrace you. And be pleased to make use of me and my endeavors to enrich them, not myself. Such being my only request unto you, spare me not in what your wisdoms shall find me useful, who do esteem myself, not only by the act of the water-commanding engine (which so cheerfully you have past), sufficiently rewarded, but likewise with courage enabled me to do ten times more for the future; and my debts being paid, and a competency to live according to my birth and quality settled, the rest shall I dedicate to the service of our King and country, by your disposals; and esteem me not the more, or rather any more, by what is past, but what is to come; professing really, from my heart, that my intentions are to outgo the six or seven hundred thousand pounds already sacrificed, if countenanced and encouraged by you, ingenuously confessing that the melancholy which hath lately seized me, (the cause whereof none of you but may easily guess,) hath, I dare say, retarded more advantages to the public service than modesty will permit me to utter; and now, revived by your promising favors, I shall infallibly be able thereunto in the experiments extant and comprised under these heads, practicable with my directions by the unparalleled workman, both for trust and skill, Caspar Kaltoff's hand, who has been these five-and-thirty years as in a school, under me employed, and still at my disposal, in a place by my great expenses made fit for public service, yet lately like to be taken from me, and consequently from the service of King and kingdom, without the least regard of about ten thousand pounds expended by me, and through my zeal, to the common good; my zeal, I say, a field large enough for you (my Lords and Gentlemen) to work upon.

The treasures buried under these heads, both for war, peace, and pleasure, being inexhaustible, I beseech you pardon me if I say so. It seems a vanity, but it comprehends a truth, since no good spring but becomes the more plentiful by how much more it is drawn, and the spinner to weave his webb is never stinted but further inforced.

The more then that you shall be pleased to make use of my inventions, the more inventive shall you ever find me; one invention begetting still another, and more and more improving my ability to serve my King and you; and as to my heartiness therein, there needs no addition, nor to my readiness a spur. And therefore, my Lords and Gentlemen, be pleased to begin, and desist not from commanding me till I flag in my obedience and endeavors to serve my King and country:

> For certainly you'll find me breathless first t'expire,
> Before my hands grow weary, or my legs do tire.

Yet, abstracting from any interest of my own, but as a fellow-subject and compatriot, will I ever labor in the vineyard, most heartily and readily obeying the least summons from you, by putting faithfully in execution what your judgments shall think fit to pitch upon amongst this century of experiments, perhaps dearly purchased by me, but now frankly and *gratis* offered to you. Since my heart (methinks) cannot be satisfied in serving my King and country, if it should cost them any thing, as I confess, when I had the honor to be near so obliging a master as his late Majesty, of happy memory, who never refused me his ear to any reasonable motion; and as for unreasonable ones, or such as were not fitting for him to grant, I would rather have to dyed a thousand deaths than ever to have made one unto him.

Yet whatever I was so happy as to obtain for any deserving person, my pains, breath, and interest, employed therein, satisfied me not, unless I likewise satisfied the fees; but that was in my golden age. And even now, though my ability and means are shortened (the world knows why), my heart remains still the same;

and be you pleased, my Lords and Gentlemen, to rest most assured, that the very complacency that I shall take in the executing your commands shall be unto me a sufficient and abundantly satisfactory reward.

Vouchsafe, therefore, to dispose freely of me, and whatever lieth in my power to perform—first, in order to his Majesty's service; secondly, for the good and advantage of the kingdom; thirdly, to all your satisfactions, for particular profit and pleasure to your individual selves; professing that, in all and each of the three respects, I will ever demean myself as it best becomes,

My Lords and Gentlemen,

Your most passionately bent fellow-subject in his Majesty's service, compatriot for the public good and advantage, and a most humble servant to all and every of you,

WORCESTER.

A Century of the Names and Scantlings of Inventions by me already practised.

1. Several sorts of seals, some shewing by screws, others by gages fastening or unfastening all the marks at once, others by additional points and imaginary places, proportionable to ordinary escocheons and seals to arms, each way palpably and punctually setting down (yet private from all others but the owner and by his assent) the day of the month, the day of the week, the month of the year, the year of our Lord, the names of the witnesses, and the individual place where any thing was sealed, though in ten thousand several places, together with the very number of lines contained in a contract, whereby falsification may be discovered and manifestly proved, being upon good grounds suspected.

Upon any of these seals a man may keep accounts of receipts and disbursements, from one farthing to an hundred millions, punctually shewing each pound, shilling, penny, or farthing.

By these seals, likewise, any letter, though written but in English, may be read and understood in eight several languages, and in English itself to clean contrary and different sense, unknown to any but the correspondent, and not to be read or understood by him neither, if opened before it arrives unto him; so that neither threats nor hopes of reward can make him reveal the secret, the letter having been intercepted and first opened by the enemy.

2. How ten thousand persons may use those seals to all and every of the purposes aforesaid, and keep their secrets from any but whom they please.

3. A cypher and character so contrived that one line, without returns and circumflexes, stands for each and every of the 24 letters, and as ready to be made for the one letter as the other.

4. This invention refined, and so abbreviated that a point only sheweth distinctly and significantly any of the 24 letters, and these very points to be made with two pens; so that no time will be lost, but as one finger riseth the other may make the following letter, never clogging the memory with several figures for words and combinations of letters, which with ease, and void of confusion, are thus speedily and punctually, letter for letter, set down by naked and not multiplied points. And nothing can be less than a point, the mathematical definition of it being, *cujus pars nulla.* And of a motion no swifter imaginable than semiquavers or releshes, yet applicable to this manner of writing.

5. A way, by circular motion, either along a rule or ringwise, to vary any alphabet, even this of points, so that the self-same point, individually placed, without the least additional mark or variation of place, shall stand for all the 24 letters, and not for the same letter twice in ten sheets writing, yet as easily and certainly read and known as if it stood but for one and the self-same letter constantly signified.

6. How, at a window, as far as eye can discover black from white, a man may hold discourse with his correspondent without noise made or notice taken; being, according to the occasion given and means afforded, *ex re nata*, and no need of provision beforehand, though much better if foreseen, and means prepared for it, and a premeditated course taken by mutual consent of parties.

7. A way to do it by night as well as by day, though as dark as pitch is black.

8. A way how to level and shoot cannon by night as well as by day, and as directly without a platform or measures taken by day, yet by a plain and infallible rule.

9. An engine portable in one's pocket, which may be carried and fastened on the inside of the greatest ship, *tanquam aliud agens*, and at any appointed minute, though a week after, either of day or night, it shall irrecoverably sink that ship.

10. A way, from a mile off, to dive and fasten a like engine to any ship, so as it may punc-

tually work the same effect either for time or execution.

11. How to prevent and safeguard any ship from such an attempt by day or night.

12. A way to make a ship not possible to be sunk, though shot an hundred times betwixt wind and water by cannon, and should lose a whole plank, yet in half an hour's time, should be made as fit to sail as before.

13. How to make such false decks, as in a moment should kill and take prisoners as many as should board the ship, without blowing the decks up or destroying them, from being reducible, and in a quarter of an hour's time should recover their former shape, and to be made fit for any employment, without discovering the secret.

14. How to bring a force to weigh up an anchor, or to do any forcible exploit, in the narrowest or lowest room in any ship, where few hands shall do the work of many; and many hands applicable to the same force, some standing, others sitting, and by virtue of their several helps, a great force augmented in little room, as effectual as if there were sufficient space to go about with an axle-tree, and work far from the centre.

15. A way to make a boat work itself against wind and tide, yea, both without the help of man or beast; yet so that the wind or tide, though directly opposite, shall force the ship or boat against itself, and in no point of the compass, but it shall be as effectual as if the wind were in the *pupp*, or the stream actually with the course it is to steer, according to which the oars shall row, and necessary motions work and move towards the desired port or point of the compass.

16. How to make a sea-castle or fortification cannon proof, and capable of containing a thousand men, yet sailable at pleasure to defend a passage; or, in an hour's time, to divide itself into three ships, as fit and trimmed to sail as before; and even whilst it is a fort or castle, they shall be unanimously steered, and effectually be driven, by an indifferent strong wind.

17. How to make upon the Thames a floating garden of pleasure, with trees, flowers, banqueting houses, and fountains, stews for all kinds of fishes, a reserve for snow to keep wine in, delicate bathing places, and the like; with music made *with mills, and all in the midst of the stream where it is most rapid.

* "By," MS. copy.

18. An artificial fountain, to be turned, like an hour-glass, by a child in the twinkling of an eye; it holding a great quantity of water, and of force sufficient to make snow, ice, and thunder, with a chirping and singing of birds, and shewing off several shapes and effects usual to fountains of pleasure.

19. A little engine within a coach, whereby a child may stop it, and secure all persons within it, and the coachman himself, though the horses be never so unruly in a full career; a child being sufficiently capable to loosen them in what posture soever they should have put themselves, turning never so short, for a child can do it in the twinkling of an eye.

20. How to bring up water balancewise, so that as little weight or force as will turn a balance will be only needful, more than the weight of the water within the buckets, which counterpoised, empty* themselves one into the other, the uppermost yielding its water, how great a quantity soever it holds, at the self-same time the lowermost taketh it in, though it be an hundred fathom high.

21. How to raise water constantly with two buckets only, day and night, without any other force than its own motion, using not so much as any force, wheel or sucker, nor more pulleys than one on which the cord or chain rolleth, with a bucket fastened at each end. This I confess I have seen and learned of the great mathematician Claudius† his Studies at Rome, he having made a present thereof unto a Cardinal; and I desire not to own any other men's inventions, but if I set down any, to nominate likewise the inventor.

22. To make a river in a garden to ebb and flow constantly, though twenty foot over, with a child's force, in some private room, or place out of sight, and a competent distance from it.

23. To set a clock in‡ a castle, the water filling the trenches about it; it shall shew by ebbing and flowing, the hours, minutes, and seconds, and all the comprehensible motions of the heavens, and counterlibration of the earth, according to Copernicus.

24. How to increase the strength of a spring to such an height as to shoot bumbasses and bullets of an hundred pound weight a steeple height, and a quarter of a mile off and more, stone-bowwise; admirable for fire-works, and astonishing of besieged cities, when, without

* "Counterpoised and empty."
† "Clavius."
‡ "As within."

warning given by noise, they find themselves so forcibly and dangerously surprised.

25. How to make a weight that cannot take up an hundred pound, and yet shall take up two hundred pound, and at the self-same distance from the centre; and so, proportionably, to millions of pounds.

26. To raise weight as well and as forcibly with the drawing back of the lever, as with the thrusting it forwards; and by that means to lose no time in motion or strength. This I saw in the arsenal at Venice.

27. A way to move to and fro huge weights, with a most inconsiderable strength, from place to place. For example, ten ton with ten pounds, and less; the said ten pounds not to fall lower than it makes the ten ton to advance or retreat upon a level.

28. A bridge, portable in* a cart with six horses, which in a few hours' time may be placed over a river half a mile broad, whereon, with much expedition, may be transported horse, foot, and cannon.

29. A portable fortification, able to contain five hundred fighting men; and yet, in six hours' time, may be set up and made cannon proof, upon the side of a river or pass, with cannon mounted upon it, and as complete as a regular fortification, with half-moons and counterscarps.

30. A way in one night's time to raise a bulwark twenty or thirty feet high, cannon-proof, and cannon mounted upon it, with men to overlook, command, and batter a town; for though it contain but four pieces, they shall be able to discharge two hundred bullets each hour.

31. A way how, safely and speedily, to make an approach to a castle or town wall, and over the very ditch, at noon day.

32. How to compose an universal character, methodical and easy to be written, yet intelligible in any language; so that if an Englishman write it in English, a Frenchman, Italian, Spaniard, Irish, Welsh, being scholars, yea, Grecian or Hebrean, shall as perfectly understand it in their own tongue as if they were perfect English, distinguishing the verbs from nouns, the numbers, tenses, and cases, as properly expressed in their own language as it was written in English.

33. To write with a needle and thread, white or any color, upon white or any other color, so that one stitch shall significantly shew any letter, and as readily and as easily shew the one letter as the other, and fit for any language.

34. To write by a knotted silk string, so that every knot shall signify any letter, with comma, full point, or interrogation, and as legible as with pen and ink upon white paper.

35. The like, by the fringe of gloves.

36. By stringing of bracelets.

37. By pink'd gloves.

38. By holes in the bottom of a sieve.

39. By a lattin, or plate lanthorn.*

40. By the smell.

41. By the taste.

42. By the touch.

NOTE.—By these three senses, as perfectly, distinctly, and unconfusedly, yea, as readily as by the sight.

43. How to vary each of these, so that ten thousand may know them, and yet keep the understanding part from any but their correspondent.

44. To make a key of a chamber door, which to your sight hath its wards and rosepipe but paper thick, and yet at pleasure, in a minute of an hour, shall become a perfect pistol, capable to shoot through a breast-plate commonly of carabine proof, with prime, powder, and fire-lock, and is coverable in a stranger's hand.

45. How to light a fire and candle at what hour of the night one waketh, without rising or putting one's hand out of the bed. And the same thing becomes† a serviceable pistol at pleasure; yet by a stranger, not knowing the secret, seemeth but a dexterous tinder-box.

46. How to make an artificial bird, to fly which way and as long as one pleaseth, by or against the wind, sometimes chirping, other times hovering, still tending the way it is designed for.

47. To make a ball of any metal, which, thrown into a pool or pail of water, shall presently rise from the bottom, and constantly show, by the superficies of the water, the hour of the day or night, never rising more out of the water than just to the minute it sheweth of each quarter of the hour; and if by force kept under water, yet the time is not lost, but recovered as soon as it is permitted to rise to the superficies of the water.

48. A screwed ascent, instead of stairs, with fit landing places to the best chambers of each story, with back stairs within the noell of it, convenient for servants to pass up and down to the inward rooms of them, unseen and private.

---

* "Upon."

* "Candlestick lantern."

† "To be."

49. A portable engine, in the way of a tobacco-tongs, whereby a man may get over a wall, or get up again, being come down, finding the coast proving unsecure to him.

50. A complete light portable ladder, which, taken out of one's pocket, may be by himself fastened an hundred feet high, to get up by from the ground.

51. A rule of gradation, which with ease and method reduceth all things to a private correspondence, most useful for secret intelligence.

52. How to signify words, and a perfect discourse, by jangling of bells of any parish church, or by any musical instrument within hearing, in a seeming way of tuneing it, or of an unskilful beginner.

53. A way how to make hollow and cover a water-screw, as big and as long as one pleaseth, in an easy and cheap way.

54. How to make a water-screw tight, and yet transparent and free from breaking, but so clear that one may palpably see the water or any heavy thing, how and why it is mounted by turning.

55. A double water-screw, the innermost to mount the water, and the outermost for it to descend more in number of threads, and consequently, in quantity of water, though much shorter than the innermost screw, by which the water ascendeth—a most extraordinary help for the turning of the screw to make the water rise.

56. To provide and make, that all the weights of the descending side of a wheel shall be perpetually further from the centre than those of the mounting side, and yet equal in number and heft to* the one side as the other. A most incredible thing, if not seen, but tried before the late King (of blessed memory)† in the Tower, by my directions, two extraordinary Embassadors accompanying his Majesty, and the Duke of Richmond and Duke Hamilton, with most of the Court attending him. The wheel was 14 foot over, and 40 weights, of 50 pounds apiece. Sir William Balfore,‡ then Lieutenant of the Tower, can justify it, with several others. They all saw, that no sooner the great weights passed the diameter line of the lower§ side, but they hung a foot further from the centre; nor no sooner passed the diameter line of the upper‖ side, but they hung a foot nearer. Be pleased to judge the consequence.

57. An ebbing and flowing water-work, in two vessels, into either of which, the water standing at a level, if a globe be cast in, instead of rising it presently ebbeth, and so remaineth until a like globe be cast into the other vessel, which the water is no sooner sensible of, but that* vessel presently ebbeth, and the other floweth, and so continueth ebbing and flowing until one or both of the globes be taken out, working some little effect besides its own motion, without the help of any man within sight or hearing; but if either of the globes be taken out, with ever so swift or easy a motion, at the very instant the ebbing and flowing ceaseth; for if during the ebbing you take out the globe, the water of that vessel presently returneth to flow, and never ebbeth after, until the globe be returned into it, and then the motion beginneth as before.

58. How to make a pistol discharge a dozen times with one loading, and without so much as once new priming requisite, or to change it out of one hand into the other, or stop one's horse.

59. Another way, as fast and effectual, but more proper for carabines.

60. A way, with a flask appropriated unto it, which will furnish either pistol or carabine with a dozen charges in three minutes' time, to do the whole execution of a dozen shots, as soon as one pleaseth, proportionably.

61. A third way, and particular for muskets, without taking them from their rests to charge or prime, to a like execution, and as fast as the flask, the musket containing but one charge at a time.

62. A way for a harquebuss, a crock, or ship musket, six upon a carriage, shooting with such expedition, as, without danger, one may charge, level, and discharge them sixty times in a minute of an hour, two or three together.

63. A sixth way, most excellent for sakers, differing from the other, yet as swift.

64. A seventh, tried and approved before the late King (of ever blessed memory), and a hundred Lords and Commons, in a cannon of eight inches half quarter, to shoot bullets of 64 lbs. weight, and 24 lbs. of powder, twenty times in six minutes; so clear from danger that after all were discharged, a pound of butter did not melt, being laid upon the cannon britch, nor the green oil discolored that was first annoint-

---

* "Of."

† "Of happy and glorious," &c.

‡ "Sir W. Belford."

§ "Upper."

‖ "Lower."

* "The."

ed and used between the barrel thereof, and the engine having never in it, nor within six foot of it, but one charge at a time.

65. A way that one man, in the cabin, may govern the whole side of ship musquets, to the number (if need require) of two or three thousand shots.

66. A way that, against several avenues to a fort or castle, one man may charge fifty cannons playing, and stopping when he pleaseth, though out of sight of the cannon.

67. A rare way, likewise, for musquetoons fastened to the pummel of the saddle, so that a common trooper cannot miss to charge them with twenty or thirty bullets at a time, even in full career.

"When I first gave my thoughts to make guns shoot often, I thought there had been but one only exquisite way inventible, yet by several trials and much charge, I have perfectly tried all these."

68. An admirable and most forcible way to drive up water by fire, not by drawing or sucking it upwards, for that must be, as the philosophers calleth it, *infra sphæram activitatis*, which is but at such a distance. But this way hath no bounder, if the vessels be strong enough; for I have taken a piece of a whole cannon, whereof the end was burst, and filled it three quarters full of water,* stopping and screwing up the broken end, as also the touch-hole, and making a constant fire under it, within 24 hours it burst and made a great crack; so that having a way† to make my vessels so that they are strengthened by the force within them, and the one to fill after the other, I have seen the water run like a constant fountain-stream, 40 foot high; one vessel of water, rarified by fire, driving up 40 of cold water. And a man that tends the work is but to turn two cocks, that one vessel of water being consumed, another to force and re-fill with cold water, and so successively, the fire being tended and kept constant, which the self-same person may likewise abundantly perform in the interim between the necessity of turning the said cocks.

69. A way how a little triangle screwed key, not weighing a shilling, shall be capable‡ and strong enough to bolt and unbolt, round about a great chest, an hundred bolts, through fifty staples, two in each, with a direct contrary motion, and as many more from both sides and ends; and, at the self-same time, shall fasten it to the place, beyond a man's natural strength to take it away; and in one and the same turn, both locketh and openeth it.

70. A key, with a rose-turning pipe, and two roses pierced through endwise the bit thereof,* with several handsomely contrived wards, which may likewise do the same effects.

71. A key perfectly square, with a screw turning within it, and more conceited than any of the rest, and no heavier than the triangle-screwed key, and doth the same effects.

72. An escutcheon to be placed before any of these locks, with these properties:

1st. The owner (though a woman) may, with her delicate hand, vary the ways of coming to open the lock ten millions of times, beyond the knowledge of the smith that made it, or of me who invented it.

2d. If a stranger openeth it, it setteth an alarm a-going, which the stranger cannot stop from running out; and, besides, though none should be within hearing, yet it catcheth his hand, as a trap doth a fox; and though far from maiming him, yet it leaveth such a mark behind it as will discover him, if suspected; the escutcheon, or lock, plainly shewing what moneys he hath taken out of the box to a farthing, and how many times opened since the owner had been at it.

73. A transmittable gallery over any ditch or breach in a town wall, with a blind and parapit cannon proof.

74. A door, whereof the turning of the key, with the help and motion of the handle, makes the hinges to be of either side, and to open either inward or outward, as one is to enter or to go out, or to open in half.

75. How a tape or ribbon-weaver may set down a whole discourse, without knowing a letter or interweaving any thing suspicious of other secret than a new-fashioned ribbon.

76. How to write in the dark as straight as by day or candle-light.

77. How to make a man to fly, which I have tried with a little boy of ten years old in a barn, from one end to the other, on a hay-mow.

78. A watch to go constantly, and yet needs no other winding from the first setting on the cord or chain, unless it be broken; requiring no other care from one man than to be now and then consulted with concerning the hour of the day or night; and if it be laid by a week together, it will not err much, but the oftener

---

* "Full"—merely.

† "Found a way."

‡ "Triangle *and* screwed key shall be capable."

* "Together."

looked upon the more exact it sheweth the time of the day or night.

79. A way to lock all the boxes of a cabinet (though never so many) at one time, which were by particular keys, appropriated to each lock, opened severally and independent the one of the other, as much as concerneth the opening of them, and by these means cannot be left open unawares.

80. How to make a pistol barrel no thicker than a shilling, and yet able to endure a musquet proof of powder and bullet.

81. A combe-conveyance carrying of letters, without suspicion, the head being opened by a needle-screw drawing a spring towards them,* the combe being made but after an usual form carried in one's pocket.

82. A knife, spoon, or fork, in an usual portable case, may have the like conveyances in their handles.

83. A raspin-mill, for hartshorn, whereby a child may do the work of half-a-dozen men, commonly taken up with that work.

84. An instrument, whereby persons ignorant of arithmetic may perfectly observe numerations and substractions of all sums and fractions.

85. A little ball made in the shape of a plum or pear, being† dexterously conveyed or forced into a body's mouth, shall presently shoot forth such and so many bolts of each side and at both ends, as, without the owner's key, can neither be opened or filed off, being made of tempered steel, and as effectually locked as an iron chest.

86. A chair, made *a-la-mode*, and yet a stranger being persuaded to set down in't, shall have immediately his arms and thighs locked up beyond his own power to loosen them.

87. A brass mould to cast candles, in which a man may make 500 dozen in a day, and add an ingredient to the tallow which will make it cheaper, and yet so that the candles shall look whiter and last longer.

88. ‡ How to make a brazen or stone head, in the midst of a great field or garden, so artificial and natural, that though a man speak never so softly, and even whispers into the ear thereof, it will presently open its mouth, and resolve the question in French, Latin, Welch, Irish or English, in good terms uttering out of his mouth, and then shut it until the next question be asked.

89. White silk, knotted in the fingers of a pair of white gloves, and so contrived, without suspicion, that playing at primero, at cards, one may, without clogging his memory, keep reckoning of all sixes, sevens, and aces, which he hath discarded.*

90. A most dexterous dicing box, with holes transparent, after the usual fashion, with a device so dexterous, that, with a knock of it against the table, the four good dice are fastened, and it looseneth four false dice made fit for the purpose.

91. An artificial horse, with saddle and caparisons fit for running at the ring, on which a man being mounted, with his lance in his hand, he can at pleasure make him start, and swiftly run his career, using the decent posture with *bon grace*, may take the ring as handsomely, and running as swiftly, as if he rode upon a barbe.

92. A screw, made like a water-screw, but the bottom made of iron plate, spade-wise, which, at the side of a boat, emptieth the mud of a pond, or raiseth gravel.

93. An engine, whereby one man may take out of the water a ship of 500 ton, so that it may be calked, trimmed, and repaired, without need of the usual way of stocks, and as easily let it down again.

94. A little engine, portable in one's pocket, which placed to any door, without any noise but one crack, openeth any door or gate.

95. A double cross-bow, neat, handsome, and strong, to shoot two arrows, either together, or one after the other, so immediately, that a deer cannot run two steps, but, if he miss of one arrow, he may be reached with the other, whether the deer run forward, sideward, or start backward.

96. A way to make a sea-bank so firm and geometrically strong, so that a stream can have no power over it; excellent, likewise, to save the pillar of a bridge, being cheaper and stronger than stone walls.

97. An instrument whereby an ignorant person may take any thing in perspective as justly, and more, than the skilfullest painter can do by his eye.

98. An engine, so contrived, that working the *primum mobile* forward or backward, upward or downward, circularly or corner-wise, to and fro, straight, upright, or downright, yet

---

* "One."

† "Which being."

‡ "An engin without ye least noyse, knock, or use of fyre, to coyne and stamp 100 lb. in an houre by one man."

* "Without foul play."

the pretended operation continueth, and advanceth none of the motions above-mentioned, hindering, much less stopping, the other; but unanimously and with harmony agreeing, they all augment and contribute strength unto the intended work and operation; and, therefore, I call this *a semi-omnipotent engine*, and do intend that a model thereof be buried with me.

99. How to make one pound weight to raise an hundred as high as one pound falleth, and yet the hundred pound descending doth what nothing less than one hundred pound can effect.

100. Upon so potent a help as these two last-mentioned inventions, a water-work is, by many years experience and labor, so advantageously by me contrived, that a child's force bringeth up, an hundred foot high, an incredible quantity of water, even two feet diameter, ***so naturally, that the work will not be heard, even into the next room; and with so great ease and geometrical symmetry, that though it work day and night, from one end of the year to the other, it will not require forty shillings reparation to the whole engine, nor hinder one's day-work;**** and I may boldly call it the most stupendous work in the whole world: not only, with little charge, to drain all sorts of mines, and furnish cities with water, though never so high seated, as well to keep them sweet, running through several streets, and so performing the work of scavengers, as well as furnishing the inhabitants with sufficient water for their private occasions; but likewise supplying rivers with sufficient to maintain and make them portable from town to town, and for the bettering of lands all the way it runs; with many more advantageous and yet greater effects of profit admirable and consequence. So that deservedly I deem this invention to crown my labors, to reward my expenses, and make my thoughts acquiesce in way of further inventions; this making up the whole century, and preventing any further trouble to the reader for the present, meaning to leave to posterity a book, wherein, under each of these heads, the means to put in execution, and visible trial, all and every of these inventions, with the shape and form of all things belonging to them, shall be printed by brass plates.

In bonum publicum, et ad majorem Dei gloriam.†

* The words marked in italics not in the MS.

† "Besydes many omitted, and some of three sorts willingly not set downe, as not fitt to be divulged, least ill use may bee made thereof; butt to shew that such things are 1so within my knowledge, I will here in myne own cypher set down one of each, not to be concealed when duty and affection obligeth me."

THE CONTENTS.*

Seals abundantly significant,	No. 1
Private and particular to each owner,	2
An one-line cypher,	3
Reduced to a point,	4
Varied significantly to all the 24 letters,	5
A minute and perfect discourse by colors,†	6
To hold the same by night,‡	7
To level cannons by night,	8
A ship-destroying engine,	9
How to be fastened from aloof, and under water,	10
How to prevent both,	11
An unsinkable ship,	12
False destroying decks,	13
Multiplied§ strength in little room,	14
A boat driven against wind and tide,	15
A sea-sailing fort,	16
A pleasant floating garden,	17
An hour-glass fountain,	18
A coach-saving engine,	19
A balance water-work,	20
A bucket-fountain,	21
An ebbing and flowing river,	22
An ebbing and flowing castle clock,‖	23
A strength-increasing spring,	24
A double drawing engine for weights,¶	25
A to and fro lever,	26
A most easy level,draught,	27
A portable bridge,	28
A moveable fortification,	29
A rising bulwark,	30
An approaching blind,	31
An universal character,	32
A needle alphabet,	33
A knotted string alphabet,	34
A fringe alphabet,	35
A bracelet alphabet,	36
A pinked glove alphabet,	37
A sieve alphabet,	38
A lanthorn alphabet,	39
An alphabet by the smell,	40
An alphabet by the taste,	41
An alphabet by the touch,	42
A variation of all and each of these,**	43
A key pistol,	44
A most conceited tinder-box,	45

* "Index."

† "A *mute* yet perfect discourse, as far distant as eye can reach by day to discern colors."

‡ "Though never soe darke."

§ "Multiplying."

‖ "Flowing clock."

¶ *For weights*—wanting in the MS.

** *And each of these*—wanting.

An artificial bird, - - - - - 46
An hour water-ball, - - - - 47
A screwed ascent of stairs, - - - 48
A tobacco-tongs engine, - - - 49
A pocket ladder, - - - - - 50
A rule of gradation, - - - - 51
A mystical jangling of bells, - - - 52
An hollowing of a water-screw, - - 53
A transparent water-screw, - - - 54
A double water-screw, - - - - 55
An advantageous change of centres, - 56
A constant water-flowing and ebbing motion, 57
An often-discharging pistol, - - - 58
An especial way for carabines, - - 59
A flask charger, - - - - - 60
A way for musquets, - - - - 61
A way for a harquebuss, or crock, - 62
For sakers* and minyons, - - - 63
For the biggest cannon,† - - - 64
For a whole side of‡ ship musquets, - 65
For guarding several avenues to a town, 66
For musquetoons on horseback, - - 67
A fire water-work, - - - - - 68
A triangle key, - - - - - 69
A rose key, - - - - - - 70
A square key, with a turning screw, - 71
An escutcheon for all locks, - - - 72
A transmittable gallery, - - - 73
A conceited door, - - - - - 74
A discourse woven in tape or ribbon,§ - 75
To write in the dark, - - - - 76
A flying man, - - - - - 77
A continually going watch,‖ - - - 78
A total¶ locking of cabinet boxes, - - 79
Light pistol barrels, - - - - 80
A combe-conveyance for letters, ** - 81
A knife, spoon, or fork conveyance, - 82
A rasping mill, - - - - - 83
An arithmetical instrument, - - - 84
An untoothsome pear, - - - - 85
An imprisoning chair, - - - - 86
A candle mould, - - - - - 87
A brazen head, or speaking figure,†† - 88
Primero gloves,‡‡ - - - - - 89
A dicing-box,§§ - - - - - 90

* Forsacres.

† "For whole cannon."

‡ *A whole side of*—wanting.

§ *Or ribbon*—wanting.

‖ "A continual watch."

¶ *A total*—wanting.

** "81, 82. Conveyance for letters."

†† Wanting entirely in the MS.

‡‡ "Stamping engine."

§§ "Primero gloves." The Marquis seems to have been in doubt which he should erase—the brazen head or the dicing-box.

An artificial ring-horse, - - - 91
A gravel engine, - - - - - 92
A ship-raising engine, - - - - 93
A pocket engine to open any door, - 94
A double cross-bow, - - - - 95
A way for sea banks, - - - - 96
A perspective instrument, - - - 97
A semi-omnipotent engine, - - - 98
A most admirable way to raise weights,* 99
A stupendous water-work, - - - 100

* Wanting in the MS.

On the Equal Action and Reaction of Motions and Forces. By Dr. Arnott.

"There is no motion or action in the universe, without a concomitant and opposite action of equal amount."

This truth has otherwise been expressed—"action and reaction are equal and contrary." It is clear that if no action or movement takes place on earth but in consequence of either attraction or repulsion—and this has now been shewn—there must always be two objects or masses concerned, and each must be *attracted* or *repelled* just as much as the other, although one will have less velocity than the other, as it may be itself greater, or fixed to another mass.

If a man in one boat pull at a rope attached to another, the two boats will approach. If they be of equal size and load, they will both move at the same rate, in whichever of the boats the man may be; and if there be a difference in the sizes, and resistances, there will be a corresponding difference in the velocities, the smaller boat moving the fastest.

A magnet and a piece of iron attract each other equally, whatever disproportion there is between the masses. If either be balanced in a scale, and the other be then brought within a certain distance beneath it, the very same counterpoise will be required to prevent their approach, whichever be in the scale. If the two were hanging near each other as pendulums, they would approach and meet; but the little one would perform more than half of the journey.

A man in a boat pulling a rope attached to a large ship, seems only to move the boat: but he really moves the ship a little, for, supposing the resistance of the ship to be just a thousand times greater than that of the boat, a thousand men in a thousand boats, pulling simultaneously in the same manner, would make the ship meet them half way.

A pound of lead and the earth attract each other with equal force, but that force makes the

lead approach sixteen feet in a second towards the earth, while the contrary motion of the earth is of course as much less than this as the earth is weightier than one pound—and is therefore unnoticed. Speaking strictly, it is true, that even a feather falling lifts the earth towards it, and that a man jumping kicks the earth away.

A spring unbending between two equal bodies, throws them off with equal velocity; if between bodies of different magnitudes the velocity is greater in the smaller body, and in proportion to the smallness.

On firing a cannon, the gun recoils with even more motion or momentum in it than the ball has, for it suffers the reaction of the expelled gun-powder as well as of the ball; but the momentum in the gun being diffused through a greater mass, the velocity is small, and easily checked.

In the art of projectiles, it has lately been proposed, as promising a great saving of weight in the field or on ship board, besides other advantages, that instead of shooting round bullets from a great barrel or cannon, as at present, the bullets should be made somewhat of barrel-shape, or should have a small barrel as a tail, and should be shot away from a strong fixed spindle or closefitting ramrod, which would then constitute the piece of ordnance. Such a projectile, for the reason stated in the last paragraph, receives more momentum from a given quantity of gunpowder than a common ball does. The experiment has been tried by the ingenious proposer, Mr. Levier, with satisfactory result.

The recoil of a light fowling-piece will hurt the shoulder, if the piece be not held close to it.

A ship in chase, by firing her bow guns, retards her motion; by firing from her stern she quickens it.

A ship firing a broadside heels or inclines to the opposite side.

A vessel of water suspended by a cord hangs perpendicularly: but if a hole be opened in one side, so as to allow the water to jet out there, the vessel will be pushed to the other side by the reaction of the jet, and will so remain while it flows. If the hole be oblique, the vessel will turn round constantly.

A vessel of water placed upon a floating piece of plank, and allowed to throw out a jet, as in the last case, moves the plank in the opposite direction.

A steamboat may be driven by making the engine pump or squirt water from the stern, instead of making it, as usual, move paddle-wheels. There is a loss of power however in this mode of applying it, as will be explained under the head of "Hydraulics."

A man floating in a small boat, and blowing strongly with a bellows towards the stern, pushes himself onwards with the same force with which the air issues from the bellows pipe.

A sky-rocket ascends, because, after it is lighted, the lower part is always producing a large quantity of aeriform fluid, which, in expanding, presses not only on the air below, but also on the rocket above, and thus lifts it. The ascent is aided also by the recoil of the rocket from the part of its substance, which is constantly bursting downwards.

He was a foolish man who thought he had found the means of commanding always a fair wind for his pleasure-boat, by erecting an immense bellows in the stern. The bellows and sails acted against each other, and there was no motion: indeed, in a perfect calm, there would be a little backward motion, because the sail would not catch all the wind from the bellows.

A man supported on a floating plank, by walking towards one end of it gives it a motion in the direction opposite.

A man using an oar, or a steam-engine turning paddle wheels, advances exactly with the force that drives the water astern.

A swimmer pressing the water downwards and backwards with his hands, is sent forwards and upwards with the same force, by the reaction of the water.

And a bird flying is upheld with exactly the force with which it strikes the air in the opposite direction.

A man pushing against the ground with a stick may be considered as compressing a spring between the earth and the end of his stick, which spring is therefore pushing him up as much as he pushes down; and if, at the time, he were balanced in the scale of a weighing beam, he would find that he weighed just as much less as he were pressing with his stick.

Thus an invalid, on a spring plank or chair, who by a trifling downward pressure of his hand on a staff or on a table, causes his body to rise and fall through a great range, and thus obtains the advantage of almost passive exercise, is really lifting himself while he presses downward.

When a child cries, on knocking his head

against a table or pane of glass, it is common to tell him, and it is true, that he has given as hard a blow as he has received; although his philosophy probably, looking chiefly to results, blames the table for his head hurt, and his head for the glass broken.

The difference of momentum acquired in a fall of one foot or of several is well known: the corresponding intensities of reaction are unpleasantly experienced by a man who, in sitting down where he supposed a chair to be, unexpectedly reaches the floor.

What motion the wind has given to a ship it has itself lost, that is to say, the ship has reacted on the moving air: as is seen when one vessel is becalmed on the lee of another.

When one billiard ball strikes directly another ball of equal size it stops, and the second ball proceeds with the whole velocity which the first had—the action which imparts the new motion being equal to the re-action which destroys the old. Although the transference of motion, in such a case, seems to be instantaneous, the change is really progressive, and as follows. The approaching ball, at a certain point of time, has just given half of its motion to the other equal ball, and if both were of soft clay, they would then proceed together with half the original velocity; but, as they are elastic, the touching parts at the moment supposed are compressed like a spring between the balls, and by then expanding, and exerting force equally both ways, they double the velocity of the foremost ball, and destroy altogether the motion of that behind.

If a billiard ball be propelled against the nearest one of a row of balls equal to itself, it comes to rest as in the last case described, while the farthest ball of the row darts off with its velocity—the intermediate balls having each received and transmitted the motion in a twinkling, without appearing themselves to move.

As further illustrative of the truths, that action and re-action are equal and contrary, and that in every case of hard bodies striking each other, they may be regarded as compressing a very small strong spring between them, we may mention, that when any elastic body, as a billiard ball, strikes another body larger than itself, and rebounds, it gives to that other, not only all the motion which it originally possessed, this being done at the moment when it comes to rest, but an additional quantity, equal to that with which it recoils—owing to the equal action in both directions of the repulsion or spring which causes the recoil. When the difference of size between the bodies is very great, the returning velocity of the smaller is nearly as great as its advancing motion was, and thus it gives a momentum to the body struck, nearly double of what it originally itself possessed. This phenomenon constitutes the paradoxical case of an effect being greater than its cause, and has led persons, imperfectly acquainted with the subject, to seek from the principle a *perpetuum mobile*. A hammer on rebounding from an anvil has given a blow of nearly double the force which it had itself, for the anvil felt its full original force while stopping it, and then, equally with itself, was affected by the repulsion which caused its return.

Many more interesting facts might be adduced as examples of equal action and reaction, but these will suffice.

Canning's Life-Raft. By W. Baddeley.

[From the London Mechanics' Magazine.]

Sir,—It is probable that during the last summer many of your readers may have seen on the River Thames, in the vicinity of New London and Blackfriars Bridges, a singular-looking machine, composed of spars and floated by barrels, the object of which was not very apparent.

The machine is, however, one of considerable importance to the maritime world, being a life-raft, invented by Mr. Alfred Canning, R. N. for the relief of persons in danger of shipwreck; and as a knowledge of its construction cannot be too widely circulated, I beg to submit the following description for insertion in your Magazine.

There are two forms of Mr. Canning's raft, as represented by figs. 1 and 2.

In fig. 1, A is a main-yard or other spar, with two cross-spars, *b b*, lashed near each end of it, and kept in their places by the rope or stays *c c*. To give the necessary firmness to the machine, four of the ropes terminate in a loop at *d d*, through which a smaller cord is rove, and braced up *taut*.

The machine is floated by means of empty water-casks, one being attached to each end of the cross-spars *b b*. The projecting end of each cask is covered with a hammock, to protect them from being stove in by rocks, &c. &c. The number and disposition of the casks must, of course, be regulated according to the number of persons to be carried. When the number is great, it is advisable to place the barrels as shown by the dotted lines, to obtain sufficient buoyancy. The raft exhibited on the River was so supported.

Fig. 1.

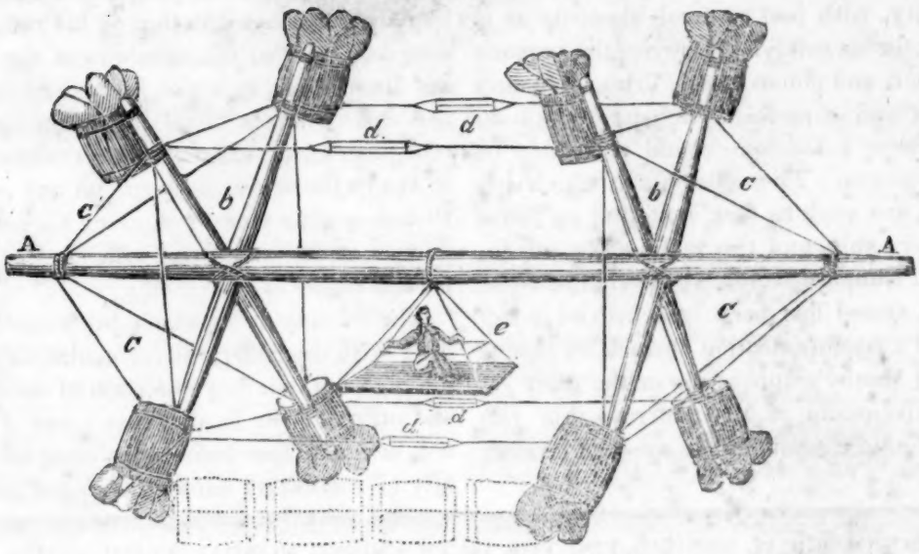
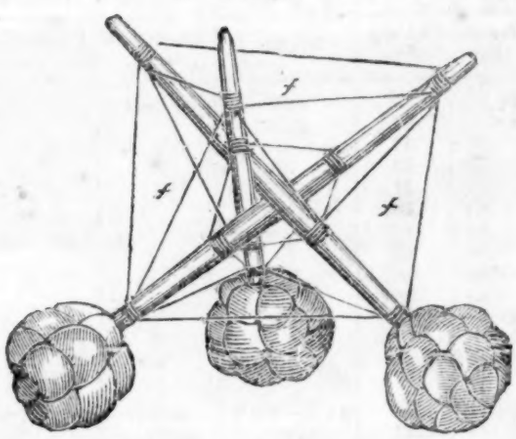


Fig. 2.



A platform *e*, for the reception of passengers, is slung upon the main-yard A by a strong loop, so as to turn freely upon it; one or two loops being used, according to the size of platform required. The loops are kept in the middle of the yard by a chock on each side of them.

It will be observed, that only four of the casks can be immersed at one time, and the object of the inventor in using twice that number is to permit the raft to roll over, without any risk to the parties on the platform *e;* that being suspended as just described, so as to retain a horizontal position whichever set of barrels may be undermost.

Fig. 2 shows another modification of this raft. It is composed of three spars, lashed together crosswise at the middle, and braced up by means of the ropes *f f f*. To each end of these spars (for the sake of clearness, one only is shown in the drawing,) is attached an empty cask, or a cork-fender, to give a requisite buoyancy. If casks are used, they should be protected with hammocks, as before described. The persons upon this raft support themselves in the centre, holding on by the ropes, and shifting themselves whenever the raft rolls over.

It is right to state, that the merits of this raft do not rest upon fresh-water experiments: Mr. Canning having made numerous trials with it on various parts of the French and English coasts, with invariable success, particularly at Cherbourg and Jersey. At the former place, a raft of the description shown at fig. 1 was drawn out to the head of the jetty in very stormy weather: Mr. Canning having seated himself on the platform, the raft was turned adrift, and was driven by the wind across the mouth of the harbor upon the rocks, and was eventually thrown by the waves, high and dry, upon a shore of the most dangerous character, without any injury either to the machine or to Mr. Canning.

The machine possesses the requisite firmness and stability, with just so much elasticity as is necessary for its safety. It carries the persons on it higher, and consequently drier, than any other raft; and is perfectly safe and certain on shores, where a life-boat would inevitably be dashed to pieces. The materials of which it is composed are such as may be found on board almost every ship, and the raft may be put together in a comparatively short period of time.

When a vessel has been wrecked on a lee-shore, and a communication formed by means of Captain Manby's apparatus, or the more recent improvements of Mr. Murray, this raft would be found a most eligible mode of landing the crew.

Mr. Canning, some time since, exhibited and explained the construction of his raft, in a lecture delivered to the members of the Mechanics' Institution, in which he gave an interesting account of several of his experiments in different places, and expressed his readiness to put to sea in the severest storm, on any part of the British coast; thereby showing his perfect confidence in the safety and efficiency of his simple life-raft.

The Society of Arts have presented Mr. Canning with their large silver medal, as a token of the high opinion they entertain of the ingenuity and utility of his contrivance; and *I guess* it will be some time before they have an opportunity of rewarding another of equal merit.

METEOROLOGICAL RECORD, FOR THE WEEK ENDING MONDAY, FEBRUARY 25, 1833.

KEPT IN THE CITY OF NEW-YORK.

[Communicated for the American Mechanics' Magazine.]

Date.	*Hours.*	*Barometer.*	*Thermometer.*	*Winds.*	*Strength of wind.*	*Clouds from what direction*	*Weather and Remarks.*
Tuesday, Feb. 19..	6 a. m.	29.68	42	SSW	moderate	WSW	cloudy
	10	.73	44	..	..	..	.. —rain
	2 p. m.	.72	44	..	..	..	rainy—cloudy
	6	.70	43	..	..	..	cloudy
	10	.75	41	..	..	..	..
Wednesday, " 20..	6 a. m.	.84	40	SSW—SW	..	..	..
	10	.89	42	WSW	..	..	..
	2 p. m.	.80	48	..	..	..	..
	6	.84	46	..	..	..	..
	10	.95	35	..	..	..	..
Thursday, " 21..	6 a. m.	30.08	25	NNW	..	..	cloudy—fair
	10	.15	30	NW—WSW	..	WSW / —— / WNW	fair—scud cloud from WNW
	2 p. m.	.11	34	WSW—WNW	fresh	W by S—WNW	..
	6	.14	32	WNW	moderate	..	..
	10	.19	30	..	..	..	clear
Friday, " 22..	6 a. m.	.20	30	SW by W	..	WSW	fair [from WSW
	10	.20	38	..	fresh	..	.. —thin cirrrous cloud
	2 p. m.	.09	45	..	strong	..	.. —beautifully variega-
	6	.00	42	..	moderate	..	.. [ted *cirri*
	10	29.98	38	..	light	..	clear
Saturday, " 23..	6 a. m.	.95	35	SW	moderate	..	..
	10	30.05	44	SW to NW	..	WSW	fair
	2 p. m.	.05	46	NW to NE	..	..	..
	6	.10	42	NE	..	..	..
	10	.15	34	NNE	..	..	.. —bank of clouds at NNW
Sunday, " 24..	6 a. m.	29.94	35	NE by E	..	WSW / —— / E	cloudy—wind scuds from E
	10	.83	38	..	..	WSW / —— / SE	.. —clouds moving swiftly
	2 p. m.	.57	46	..	..	SW / —— SSW / ESE	fair—bar. low't at 5, bank of clouds rising from WSW
	6	.47	40	NNE—NW	gale		at 7.15 sudden gale from NW
	10	.66	22	NW	..		snow [with rain and snow
Monday, " 25..	6 a. m.	30.00	18	..	fresh.strong	WSW / —— / NW	fair—wind scuds from NW
	10	.02	24	..	strong	.. / — / ..	..
	2 p. m.	.07	27	..	..	NW	..
	6	.18	24	NNW	moderate	..	..
	10	.30	22	NW	..	..	clear

Average temperature of the week, 36.16.